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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institution of British Foundrymen.

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Foundry Economies.

Foundrymen are bitterly complaining of the present shortage of coke, which is obviously associated with high export prices, and they are considering seriously their forward buying. On this subject we tender no advice, as it is intimately connected with the industrial exploitation of the Ruhr coalfield, and so becomes a political question. During the war, British industries had constantly to meet similar situations; so, too, had the Germans, to create large quantities of "ersatz" materials. A situation analogous to that now existing in Great Britain arose in Austria, and attempts were made to meet it by the introduction of auxiliary oil-firing in the cupola. We have seen the experiment repeated in Belgium, where we were assured that it was a technical, if not a commercial, success. British commercial conditions should allow of the purchase of oil relatively much cheaper than in Belgium, which should lessen the distance between the technical and the real commercial success. This is only one direction where coke may be saved. Towns gas is available in large quantities in many districts, and can be utilised for mould- and core-drying purposes. Again, the installation of a gas producer is a commercial proposition for many foundries. Electricity, too, can be utilised for melting steel, iron, or any non-ferrous material, for mould or core drying, and for any type of heat treatment. Obviously oil, too, can everywhere replace coke, except wholly in the cupola, where certainly it can eliminate the major portion. We do not suggest that any or all these changes are possible in all foundries, but in some we know they are partially applicable. A very important works in the London area changed over from boiler slack and gas producers to oil firing during the last coal strike, and affirm that they do not intend changing over again. This works would require 80 to 100 tons of coal per day. Whilst on the subject of oil firing of cupolas, it should be pointed out that it eliminates the use of wood for kindling, and ensure a good starting up. Some firms on the Continent think oil worth while for this purpose alone. Oil-producer and towns gas are to be preferred for ladle drying, as a fire started in a ladle with damp wood can be distinctly objectionable.

Another fuel economy, worth while the consideration of foundries engaged on the repetition manufacture of fairly heavy castings, such as ingot moulds, is the construction of a combination soaking pit and mould-drying stove, by means of which the heat from the cooling casting is utilised to dry a mould for the next one. But, after all, where in the average foundry in Great Britain could one not save money? We believe there exists in the boiler trade, a firm which guarantees savings in boiler practice, and does not require payment until the economies effected cover their charges for the improvements made. German firms, too, before the war installed labour-helping devices and afforded credit until the money saved covered their account. To-day a splendid opportunity occurs for real live foundry experts, with a little capital, to conduct business on these lines. Unfortunately, foundry costing is difficult, and many foundries would be unable to give the specialist a true estimate of particularised costs. There are not a few foundries where enterprising firms with capital could usefully contract to replace existing obsolete metallurgical plant—replace it with modern material and take payment in the shape of the value of the fuel saved as such accrues. With this there is always associated the question of banking facilities. The German banks before the war were particularly good in this direction, and any firm who feels they could do business on these lines should impress it upon their bankers that banks should be in a position to examine the technical as well as the financial aspects of such propositions by the appointment of an engineering and metallurgical staff. This would help a revival of trade just as much as any system of export credits.

Institution of British Foundrymen.

This year, the Burnley Section, instead of holding a dinner, organised a whist drive, as they felt that this afforded the best opportunity of promoting the social welfare of the Section. The experiment proved entirely successful. Mr. J. Hogg presided, and Mr. J. Pell, the Section secretary, acted as M.C. Prizes were provided by Mesdames Hogg, Layfield and Pell, and Messrs. Fawcett, Faulkner, Hartley, Harling, Place and Pollard. The first prizes were won by Mrs Pollard and Mr. R. Crabtree.

XUM

A New British Moulding Machine.

A new hand jolt-ram moulding machine has been placed upon the market by the well-known machine-tool manufacturing firm of Messrs. The Denbigh Engineering Company, Limited, of Tipton, Staffordshire. It has been christened with the rather striking name of "It's It."

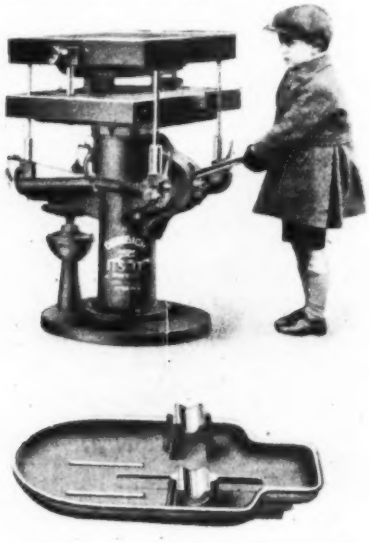
It is fully covered by patents, and a further patent just taken out will enable patterns of any depth to be stripped from the mould.

The machine is stated to be just as efficient when used as a hand-ram pattern-drawing machine where hand ramming is necessary, and also as a hand-jolt and pattern-drawing machine, thereby eliminating the jolt-power machines with their costly pneumatic or hydraulic plant.

The ramming by hand jolt is claimed to be a matter of seconds only, and equals the time taken by any power machine.

No foundations whatever are required. It is placed on the foundry floor in the position selected, and it is ready for operation at once. In other words, the machine can be taken to the job instead of the job to the machine.

The machine is constructed so that various sized and shaped boxes can be worked on the same machine by a simple and quick adjustment of the lifting pins, and, further, great care has been taken in the design so as to prevent any sand getting into the working parts.



The "It's It" Moulding Machine.

The makers of this machine have had many years' practical experience in foundry work, having one of the largest foundries in the Midlands, and they therefore are fully satisfied that the machine is a practical proposition, after giving it several months' severe tests in their own foundry.

Simplicity is another feature, one lever operating the ramming and pattern drawing, which makes the machine as near "fool-proof" as possible.

Four sizes of the machine are on the market, covering a range of work from 1 cwt. to one ton.

The question naturally arises as to how it is possible to jolt 5-10 cwt. or a ton easily by hand, but the machine is provided with an oil-compensation device, which can be adjusted in a few seconds, enabling any weight to be balanced, so that it can be jolted by a boy of five years of age, as shown in the illustration. Obviously, as there is no power, compressors, etc., required, the running costs are nil.

The makers themselves have discarded their pneumatic plant, including many well-known makes, covering the capacity of these hand-jolters, as the workmen prefer the hand machines.

Messrs. John M. Terry and Company, of 5, 6 and 7, Great Hampton Street, Birmingham, who have been appointed the sole selling agents, have arranged to give demonstrations to interested foundrymen at this address, or, alternately, they are prepared to send a demonstration lorry to the actual foundries.

Obituary.

Mr. T. Y. Howcroft, a former works manager for Richard Hill & Company, Limited, of Middlesbrough, died recently.

Mr. M. Pape, a director of the Campbell Gas Engine Company, Limited, of Kingston, Halifax, died on February 3 in his 68th year.

Mr. A. H. Assinder, a director of Peyton, Hoyland & Barber, Limited, bedstead manufacturers, of High Street, Bordesley, Birmingham, died on February 8, aged seventy. The deceased gentleman founded the Empire Bedstead Works, which were subsequently allied to Peyton, Hoyland & Barber, Limited. He was also connected with Crofts & Assinder, Limited, brass founders, of Lombard Street, Birmingham.

Mr. D. Cochrane, inventor of the open feed-water heater which bears his name, died recently in the United States. Mr. Cochrane was born in a Clackmannanshire village in 1850, and in his early years worked as a pattern-maker on the Clyde. He went to the United States in 1879, finding employment with Ferris & Miles. Shortly afterwards he joined the Harrison Safety Boiler Works and brought out his heater in 1883.

Mr. H. C. Brooklyn Mushet has died in his 78th year in London. Mr. Mushet was well known in Sheffield, although it is many years since he left the city. He was the son of Mr. R. Forrester Mushet, who was the inventor of "Mushet steel," a self-hardening tool steel which is still in use. He formerly lived in Wellesley Road, Sheffield, and was with Samuel Osborn & Company, Limited, Clyde Steel Works, The Wicker, for a considerable number of years, and superintended the manufacture of the "Mushet steel" at those works. He retired many years ago.

Mr. H. L. Wade died last week, after a brief illness. Mr. Wade, who was in his 68th year, was a son of the late Mr. Charles Wade, and with his father and his brother Charles, some forty-five years ago, founded the business now carried on in Aston Road, Birmingham, of Charles Wade & Company, Limited, iron and steel merchants and constructional engineers. Mr. Wade left Birmingham in November last, apparently in the best of health, and it had been his intention to leave India shortly on a business journey to South Africa, where in 1902 he founded the firm of Wade & Dorman, Limited.

Foundry Queries.

Cupola Preservation.

We shall be glad if you can put us in touch with makers of a suitable coating for treating foundry cupolas externally. In the past we have used ordinary tar, but find that whilst this has the latter property, it easily peels off owing to the heat of the furnace and requires to be applied far too frequently.—K. E. W.

Gazette.

The shareholders of Mild Steel Castings, Limited, have decided to wind up the company voluntarily. Mr. W. H. Watkins, 91-93, Bishopsgate, E.C.2, is the liquidator.

The Wyre Slipway and Engineering Company, Limited, are being wound up voluntarily, with Mr. C. Bowman, 10, Albert Street, Fleetwood, as liquidator.

The partnership heretofore subsisting between Messrs. H. Woollacott and C. A. Woollacott, Worsley Gear Works, Worsley Street, Hulme, Manchester, under the style of H. Woollacott & Company, has been dissolved.

Messrs. C. Brooks, H. B. Bleasdale, and S. G. Williams, engineers and machine brokers, Woodfield Mill, Miller Street, Heywood, and 48, Pennington Road, Bolton, trading under the style of The New Era Machine Company, have dissolved partnership. Mr. C. Brooks and Mr. S. G. Williams, will continue.

The names of the undermentioned companies have been struck off the Register of Joint Stock Companies, and such companies are dissolved:—Absolute Lock-Nut Company, Limited, Alliance Engineering Company, Limited, British Stamping Works, Limited, Eastern General Welding & Brazing Works, Limited, Elpo Electrical Engineering Company, Limited, Electrical Engineering Company, Limited, National Electric Engineering Company, Limited, Newsons Engine Syndicate, Limited, and Still's Tube Syndicate, Limited.

Mechanical Appliances in the Foundry.*

By Prof. G. F. Charnock, M.Inst.C.E.

The object of the present Paper is to discuss the question of transportation applied to the jobbing as well as to the specialised foundry from the

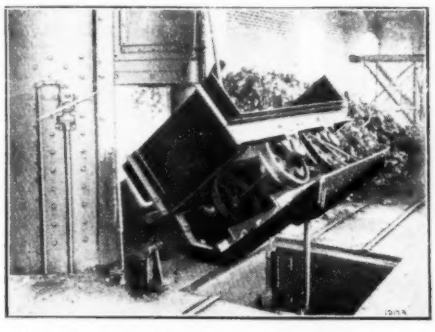


FIG. 1.—SIDE DUMP CHARGING MACHINE IN DUMPING POSITION.—THE WHITING CORPORATION, CHICAGO.

standpoint of the mechanical engineer. The problem of mechanically handling raw and finished material might be studied to a far greater extent than has hitherto been done in this country. Many foundries are unfortunately situated so far from the railway track that all material has to be brought into them by team labour. Unloading of pig-iron from a truck is accomplished by five or six labourers, some handing out the pigs, which others carry away to the pile. Another gang of men may be engaged in unloading a truck of moulding sand, whilst others wheel it into the foundry. Coke is handled in a similar manner. Further, many British foundries to-day wheel the raw material in barrows by hand labour from the stock-yard to the foundry.

In many cases it may be that this practice is continued owing to the impossibility of making the necessary alterations to enable any form of mechanical transport to be installed. But it is to be feared that more frequently it is due to the fact that in the past the British mechanical engineer has viewed the foundry with a great deal of ignorance and with considerable contempt, regarding it as beneath him to advise the foundryman how his material should be handled. There are signs, however, that engineers in this country have at last awakened to the fact that the foundry is well worthy of the application of their mechanical ingenuity.

The absence of mechanical handling of materials is by no means confined to those foundries which are not in possession of a railway siding. In many British foundries belonging to works the reputation of which is famous throughout the world, the practice is still in vogue to tip the contents of railway trucks, whether pig-iron, scrap, fuel or sand, directly on to a dump in the stock-yard, from whence it is wheeled by hand labour to the position in the foundry where it is required. In America the plan is frequently met with of bringing railway trucks or motor wagons, as the case may be, up an inclined road, so that metal and fuel may be deposited on the cupola charging-

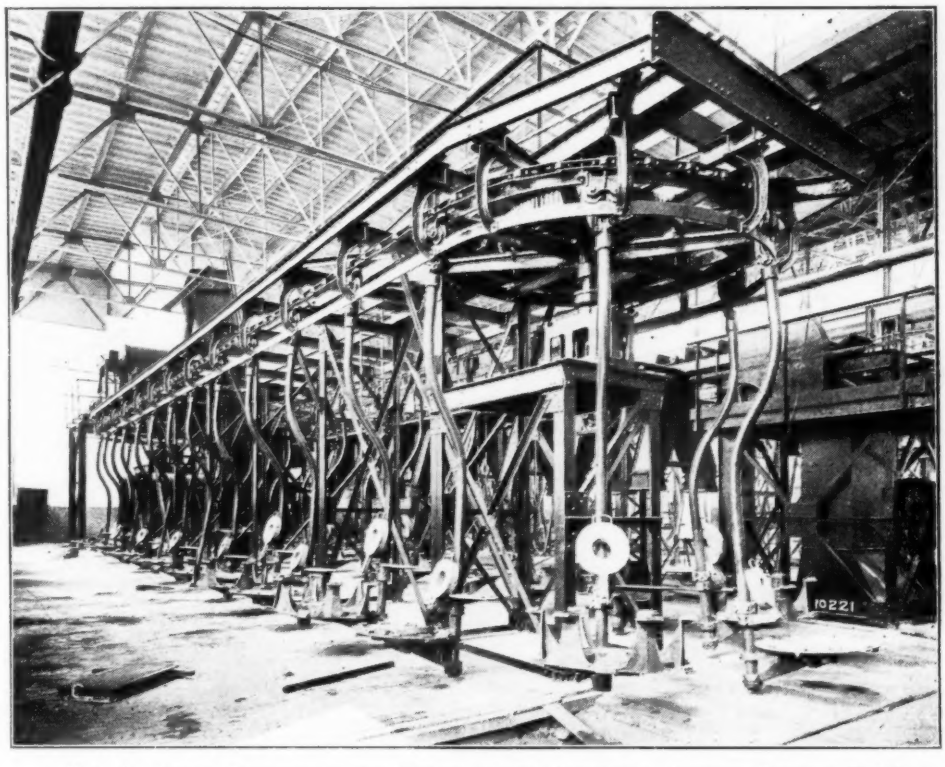


FIG. 2.—MOULD CONVEYOR IN THE KELSEY WHEEL COMPANY'S FOUNDRY, DETROIT, U.S.A.

platform itself, whilst sand and other foundry materials are dumped by gravity into storage bins below. As this is obviously the simplest way of handling material entering the foundry, it is remarkable to find how rarely it has been adopted in this country. It is true that several new foundries have been built during the last few years in which the stock-yard has been laid out on somewhat similar lines, but this has been done because the natural slope of the land surrounding the building lent itself to the construction of an inclined siding. In the case of new foundries generally, a great advantage can be gained by actually building up an inclined roadway for this

* Paper read before the Institution of British Foundrymen at Halifax, Feb. 3rd, 1923, Mr. A. A. Liardet in the Chair.

purpose, and probably about 25 per cent. of existing British foundries could readily install at reasonable cost and with very little inconvenience an inclined track of this nature. This might be either a steel or a stone structure, with a simple ropeway system for hauling railway trucks up to the desired level. The cupola staging could then be extended to give storage room, and the weighing out of material into the trucks for charging direct into the cupolas could be carried out entirely on the platform level.

Method of Handling Material in the Stock Yard.

Where the tonnage handled is sufficient to warrant the investment, say in plants having a capacity of 50 tons per day or more, an overhead travelling or gantry crane covering the storage yard should be installed. This should have high speed movements, and be fitted with an electromagnet for unloading pig and scrap. An example of 5-ton 3-motor electric overhead travelling crane with magnet for handling pig by Messrs. H. Morris, Limited, of Loughborough, was shown and described in this connection. In plants of moderate capacity, jib cranes may be substituted for the traveller, or a simple overhead runway may be installed operated by electric trolley hoist, which latter system is particularly suitable for the purpose. In such a case the usual capacity is for working loads of from 1 to 2 tons, and control is effected from the driver's seat in a cabin suspended from the hoist, which enables rapid travelling, say from 200 to 300 ft. per minute, to be adopted.

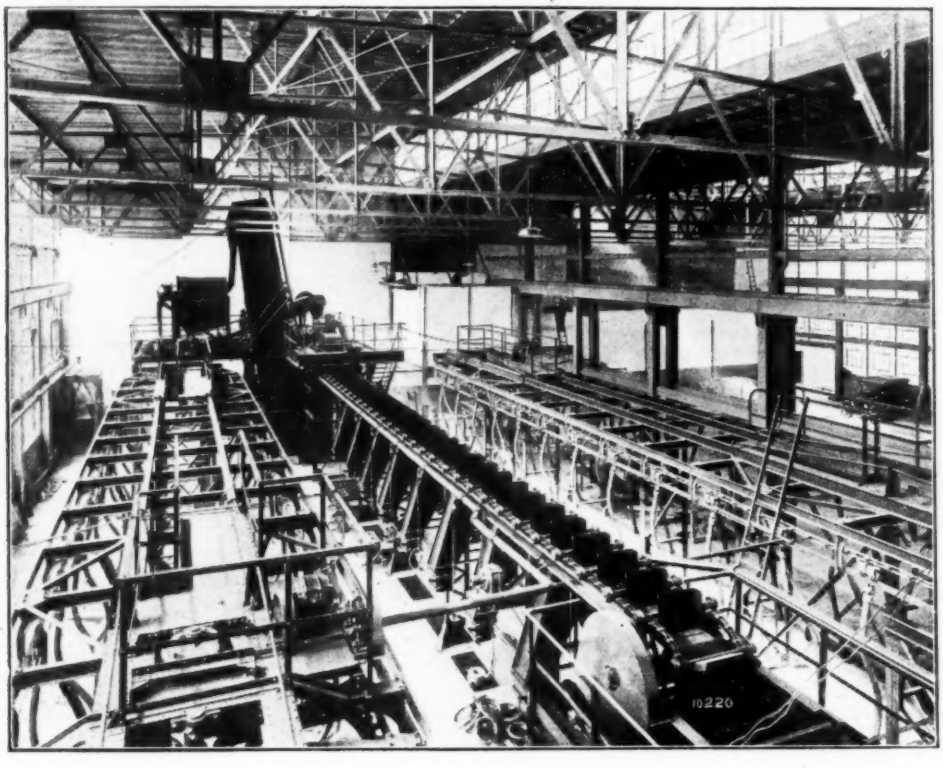


Fig. 3.—Casting Tracks and Sand Handling Plant.—The Kelsey Wheel Company, Detroit.

Method of Delivering Materials to Cupola.

The charge should be made up in trucks, which are loaded in the stock-yard with the proper amounts of metal and fuel, each selected and weighed according to requirements, and not again handled until introduced into the cupola. Trucks of 2 tons capacity, fitted with ball or roller bearings, can easily be moved on a level track by one man. This subject must be studied in conjunction with the method of charging the cupola, which in turn governs the lay-out of the charging floor.

Methods of Charging Cupola.

The commonest method, although extremely laborious, is to charge by hand. In recent years, however, a considerable saving has been effected by the introduction of mechanical charging devices, which are now in successful use in America, Germany, France, and Belgium, and to a limited extent in this country.

Many practical foundrymen of wide experience still contend that mechanical charging cannot give such good melting results as the older method of hand charging. It is difficult to find any valid reason to back up this opinion. The main objection seems to be that with mechanical means the charge is liable to lie at an angle in the cupola, thus causing alternate layers of coke and iron to mingle, and not lie horizontally one upon the other. There is no doubt, however, that this difficulty can be overcome by making use of a distributor of the proper shape and size.

The mechanical charging of cupolas may be effected in several ways; first, by an inclined skep hoist, which elevates small trucks from the ground level and tips the metal and coke direct into the cupola. This does away with the necessity for a charging platform. Undoubtedly, in the case of a small or medium-sized foundry, this is the only method which would not be prohibitive in first cost. In a recent installation of 4-ton cupola by Messrs. Thwaites Brothers, Limited, of Bradford fitted with a charging machine, the hoist is operated by an electric motor which runs continuously, and the control is by single hand lever having three positions:—(1) "Up," for hoisting; (2) "mid," to suspend the load; and (3) "down," to lower. The handle returns automatically to mid position when released, thus applying the brake. An automatic knock-off gear cuts off the hoisting motion when the truck reaches its tipped position. A special form of hopper is fitted to the charging door, which causes the contents of the truck to slide slowly into the cupola, at the same time spreading the charge, and avoiding any tendency to heap up against one side of the cupola.

The second method of mechanical charging is by means of trucks or small wagons to contain the necessary charges, which are raised by vertical hoist to the platform level. Here the trucks run on rails, turntables being employed to bring the trucks opposite the charging door of the cupola, into which their contents are directly tipped. This type of hoist is operated by an electric motor,

and is fitted with automatic cage-operated collapsible gates, limit switches, and electrical and mechanical brakes. An interesting modification (Fig. 1) of this method of charging is due to the Whiting Corporation of Chicago, and is in extensive use in the States. The loaded trucks on arrival at the platform level are placed on an electrically-operated transporter having on it a turntable. The transporter moves the trucks opposite one or other of a set of rails which lead directly to the sides of the cupola charging doors, and also to the other rails on the platform, so that loaded trucks may be kept in proper position for rapid charging, and when empty may be circulated in the proper direction for making the descent.

The third system of charging is by means of an overhead runway, having an electrically-operated trolley hoisting gear, which lifts the material from the stock-yard, transports it, and delivers it directly into the cupola. This is probably the most satisfactory, although it may be the most expensive method of dealing with the problem. An overhead electric runway of this type, with turntables serving cupolas, constructed by the Vaughan Crane Company, Limited, of Manchester, for the G.N.R. Company's works, Peterborough, was alluded to.

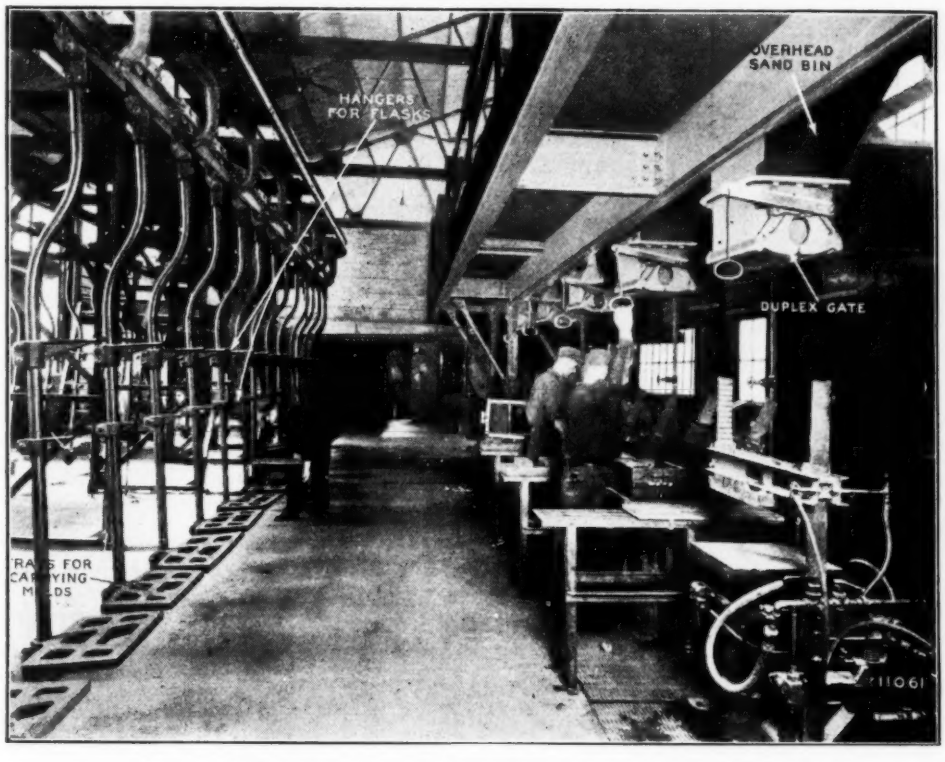


Fig. 4.—Method of Filling Flasks from Overhead Sand Bins.

An extremely interesting and complete example of cupola charging on the runway system has been devised by Mons. L. Thomas, general manager of the firm of A. Piat & Sons, Soissons, France, who has kindly furnished the following particulars. A small wagon filled with pig-iron is waiting on the ground level at the despatching position, when the workman on the charging platform operates a controller which causes the hook of the electric hoist to descend, this hoist being attached to a trolley on the overhead runway, and having been brought to rest immediately over the small wagon. The workman in the stock-yard on the ground floor hooks on the wagon, which is then raised to the level of the overhead girder by another movement of the controller. The electric hoist, with its load, then starts automatically to move along in the direction of the foundry, and finally is stopped automatically in front of the cupola which is in blast. The cupola charger operates a small lever attached to this cupola, which tips the wagon and allows its contents to be charged directly into the cupola. Then, by the further operation of one or other of the controllers on the platform according to which cupola is in blast, the empty wagon is carried forward on the runway and finally stopped opposite the receiving position.

The second workman employed in the stock-yard by operating another controller causes the empty wagon to descend. The wagon is fitted with wheels, and it drops on to a narrow gauge railway, while the hook, when freed from the wagon, is elevated by the electric hoist and the whole travels on the overhead runway until it arrives immediately opposite the despatching position, and so on.

Assuming that melting operations only take place in the afternoon, the work actually carried out in the stock-yard and on the charging platform is confined during the morning to the preparation and storage of the metal and fuel required for melting. In the stock-yard two men are employed breaking up the necessary pig-iron in front of each stack by means of an electrically-operated pig breaker. This is carried to the storage ground for broken pig-iron by means of an electric locomotive crane fitted with an electro-magnet. The same workman unloads the coke and pig-iron from the railway trucks.

On the charging platform a man is employed filling a certain number of flat baskets with coke which he has previously lifted out of the storage bins, and he places them close to the cupolas. This man is in charge of the working of the cupolas, and also assists his two mates in the stock-yard.

During casting the workmen in the storage yard receive the empty wagon, run it over the weigh-bridge for the scrap iron, where the necessary quantity of scrap iron is charged into the wagon, then on to a multiple arm weighing bridge, where the charge is completed with the broken-up new pig-iron, selected runners, and the necessary weighed-out flux, and finally take it to the position close to the cupola. One of these men then hooks on the wagon to the electric runway, whilst the other returns it to the receiving position to receive the empty wagon, and so on.

The workman on the platform receives the wagons one-after the other, empties them into the cupola and charges in by hand the necessary fuel which he has prepared in the morning.

The fourth and most efficient system of charging for foundries having a daily output of 30 tons or more is by means of the charging machine introduced by the Whiting Corporation of Chicago, and extensively employed in the States. The truck is raised to the charging platform as in the second system, and is run on to a hinged floor-plate immediately in front of the charging door, which is then locked in position. A pneumatic hoist raises the floor-plate and dumps the charge bodily into the cupola, as shown in Fig. 1.

Lifting and Conveying Equipment in the Foundry.

The provision of suitable crane equipment is essential when the large amount of heavy lifting which attends the handling of most foundry work is considered, and by careful selection of the proper hoisting and conveying appliance a great saving can often be effected, both in the initial outlay and in keeping down production costs. For a foundry turning out heavy machinery castings, the main bay should be spanned by an electric overhead travelling crane running the full length of the building, so as to serve the heavy moulding floor in setting patterns and cores, closing moulds, shaking out, etc. Several fine examples of 3-motor cranes of this type with cage control as constructed by the Vaughan Crane Company, Limited, were illustrated and described.

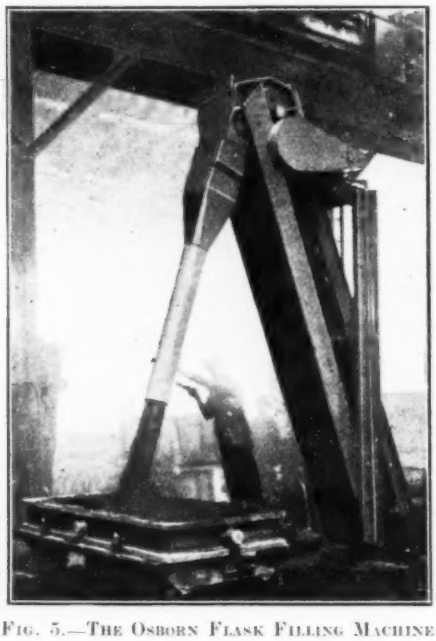


Fig. 5.—The Osborn Flask Filling Machine.

In a small foundry where there is not sufficient work for an electric overhead traveller, a hand-power floor-operated travelling crane is to be recommended. In some cases a motor is applied to the hoisting mechanism only, longitudinal and cross travelling being performed by pendant hand chains. There is, however, much to be said for the provision of a power travelling arrangement by preference, as in this way much time may be saved and the general handiness of the crane greatly increased. Overhead travellers are always preferable to jib cranes, as they cover practically every square foot of the floor space, and, moreover, their service is readily extended by lengthening the side tracks should any addition to the building be made.

Where the class of work produced is light or where head room is limited, an overhead runway system may be more practical than a crane. Such a mono-rail system may be fitted either with electric- or hand-power trolley running on the lower flange of the girder which forms the track. This system possesses great flexibility, and may be readily extended to remote points when required. Branch lines to right or left may be run off entirely self-contained, and the switching mechanism may be embodied in the trolley if required. An instance of the use of this system on a large scale at Messrs. E. Green & Son's foundry, Wakefield, was referred to, for particulars of which the author is indebted to Mr. J. Haigh, foundry manager. Here an electric trolley hoist is used for transporting metal from the cupola to various parts of the foundry, and a large number of similar trolleys are arranged to serve the various bays of the shop. This system has also been largely developed in America, where it is known as the "electric tramrail."

In addition to careful and rapid handling, smooth working in a foundry is essential, and objection has been raised that finished moulds, when carried on a runway, are liable to be shaken out, and delicate cores are subject to risk of breakage. For service requiring accurate control and steady action, such as lifting flasks, drawing patterns, setting cores, and closing moulds, pneumatic hoists are extensively used. These are suspended from trolleys, operating on the lower flange of overhead runway girders, jib cranes, etc.

The overhead runway down the centre of the building, in conjunction with hand travelling cranes right and left, forms a most effective combination for a light foundry. A typical iron-foundry lay-out on this system was described, in which the travelling cranes were provided with underhung girders, so that the mono-rail girder and the underhung girder of the crane can be brought exactly opposite each other, and the top flanges locked together by suitable mechanism, so that the trolley may pass from one to the other without interruption. When the lock is opened a stop drops automatically, and prevents the trolley slipping off the end of the beam.

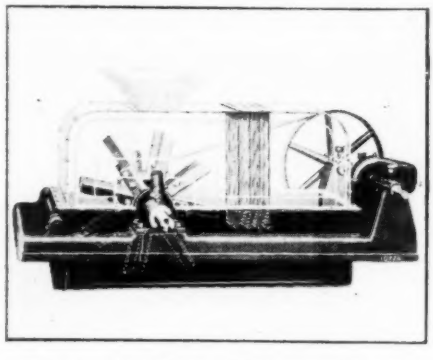


Fig. 6.—The Rapp "Revivifier" for Moulding Sand.

The "Continuous" Foundry System.

It has been said in America that a continuous and complete foundry system is one in which a moulder does nothing but mould, a core maker does nothing but make cores, a pourer does nothing but pour, a labourer's sole duty is to shake out the moulds, and another's time is occupied entirely in conditioning the sand. Each should stand in his place and have everything brought to and taken from him by elevating and conveying machinery specially designed for the purpose. It is claimed that this system has been carried out in a large number of cases with great economic success by the Link Belt Company, of Chicago, U.S.A., and also that there is scarcely a foundry of any kind which does not afford opportunities of increasing its profits by adopting the continuous production system in a greater or less degree.

To explain the origin of this system, attention might first be drawn to the "Carrousel" or "roundabout" casting machine, which has been in use for many years at the Horwich Locomotive Works of the (late) Lancashire and Yorkshire Railway. Through the courtesy of Mr. G. N. Shawcross, the divisional engineer, a view was shown of this foundry, which is 111 ft. span and 486 ft. long, with a row of casting machines down one side. The circular table of this machine revolves with very little friction, and affords a convenient means of transporting the moulds as completed at the moulding machine to a suitable point for casting. A great advance in the development of this idea was made by the Link Belt Company in arranging a number of tables large enough to accommodate the mouding boxes, and capable of travelling continuously on friction rollers fixed in a suitable track. The tables are coupled together by a continuous chain or "link belt" driven by

sprocket wheels at convenient points underneath the track. The sprocket wheels are actuated through gearing, or may be driven by electric motors. It will be seen that the moving track need not necessarily follow a circular path, but may be elliptical or any other convenient form. The principle of the overhead runway was next combined with the moving track, resulting in the suspended tray mould conveyor, of which a remarkably fine example was erected by the Link Belt Company in the Ford Motor Company's foundry, in which the ladle, on its own independent runway for bringing the metal from the cupola, is a special feature of the installation. Fig. 2 shows the mould conveyor in the Kelsey Wheel Company's foundry, engaged in the manufacture of wheels for the "Fordson" tractor. This conveyor is combined with sand-preparing and distributing machinery, as seen in Fig. 3. From the preparing machinery the sand is delivered to storage bins immediately over the ramming stools on which the moulding machines are placed, so that by means of an ingenious form of duplex gate the sand is discharged directly from the bins into the boxes below, Fig. 4.

As an alternative to the method of filling the boxes direct from sand-bins overhead, in the case of a large moulding machine engaged on repetition work, an elevator may be attached to the machine itself. As an illustration, the flask filling machine, made by the Osborn Manufacturing Company, Limited, Cleveland, U.S.A., was alluded to. It consists of a "belt and bucket" elevator, having a capacity of 2 cub. yards of sand per minute, and in the illustration, Fig. 5, is shown attached to a plain jolt-ramming machine operated by air.

Sand-Preparing and Conveying Machinery.

Sand-preparing and conveying machinery is an essential feature of the continuous-production system. A modern foundry is not complete unless it is equipped with a good system of sand conveying, which delivers the sand automatically to the place where it is used. It dispenses with the wheelbarrow, and to a great extent with the shovel. As the quantity of sand to be dealt with amounts on the average to twenty times the weight of the castings turned out, it is obvious that the use of mechanical appliances must economise labour, and tend towards better work.

In America, what is known as the Rapp "Revivifier" has come into extensive use, its purpose being to aerate, cool, and thoroughly mix the moulding sand (Fig. 6). In principle it is a modification of the disintegrator invented in this country by Carr many years ago. The used sand, after water and a small percentage of new sand, or of some compound to restore old sand, has been added, is delivered in the receiving hopper of the revivifier. To the main shaft, which runs at a high speed, are attached beater arms of flat steel, set at such an angle as to drive forward two streams of sand across each other, and against a curtain of suspended steel rods. These rods are staggered so as not to allow any particles of sand to pass through in a straight line. The impact breaks up the lumps or pellets, and the action of the revolving blades assures thorough mixing of all particles. A machine capable of dealing with 50 tons of sand per hour requires 10 h.p. to drive it. The machine is placed in some convenient central position in the foundry, to and from which the sand is transported by conveyors.

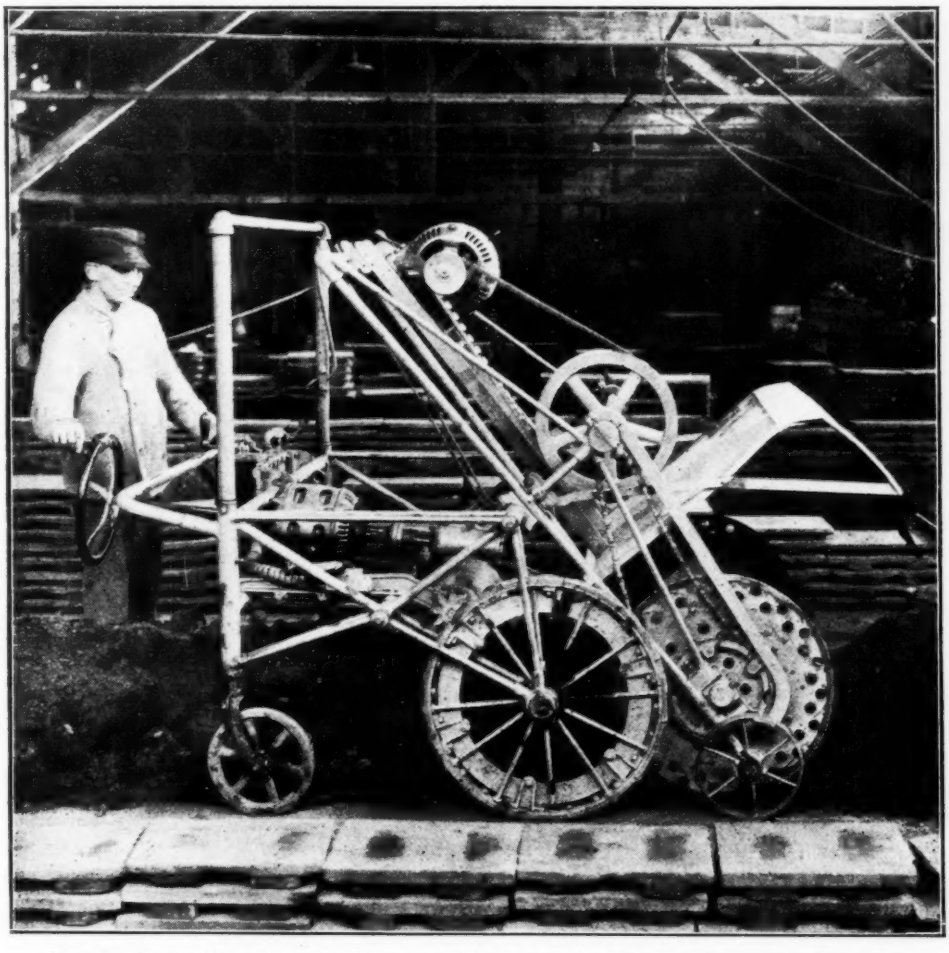


FIG. 7.—POWER SAND CUTTING MACHINE.—THE AMERICAN FOUNDRY EQUIPMENT COMPANY.

Sand Cutting Machines.

Of course, it may be said that this arrangement is only suitable for an installation on a very large scale, and in the medium- and smaller-sized foundry there is at the present time a growing tendency to prepare the sand on the spot where it is wanted. In this way the sand-cutting and

screening machine has been developed, which at one operation cuts, aerates, screens, and tempers the sand with perfectly uniform results and much less cost than hand labour. Fig. 7 shows a power sand-cutting machine by the American Foundry Equipment Company, of New York, which has been termed the "Ford of the Foundry." Ten helical steel shovels, Fig. 8, are arranged in a cylinder which revolves 150 times per minute, making 50 cuts per lineal foot. These slice, toss, and mix the sand, thoroughly blending the new sand with the old, and forming it into a ridge or windrow at the rate of 15 feet of floor length per minute. The cutting motion is driven by a 2-h.p. motor, and travelling is accomplished by a small motor of ½ h.p., reversible and variable speed transmission with differential drive being provided. Power is brought to the motors by flexible cable from plugs located at convenient points in the foundry. Such a machine is capable of doing good service in a foundry where the moulds are always above the floor.

Returning to a consideration of the continuous system, the essential features in the lay-out of a modern foundry sand-handling plant were dealt with by reference to the general arrangement of the sand-handling equipment (Fig. 9) installed by the Link Belt Company for the Wolff Manufacturing Company, of Chicago, who are manufacturers of bath tubs and sanitary ware on a very large scale. This diagram may be compared with the photographic view, Fig. 2, which also shows the arrangement of the reclaiming and distributing conveyor and of the mould conveyors.

Lay-Out of Plant on the Continuous System.

The same principle was further elucidated by reference to the lay-out of a plant having an hourly capacity of 150 castings each weighing about 1 cwt., and requiring about 9 tons of molten metal per hour.

The melting plant consists of two cupolas used alternately, one day at a time, each capable of

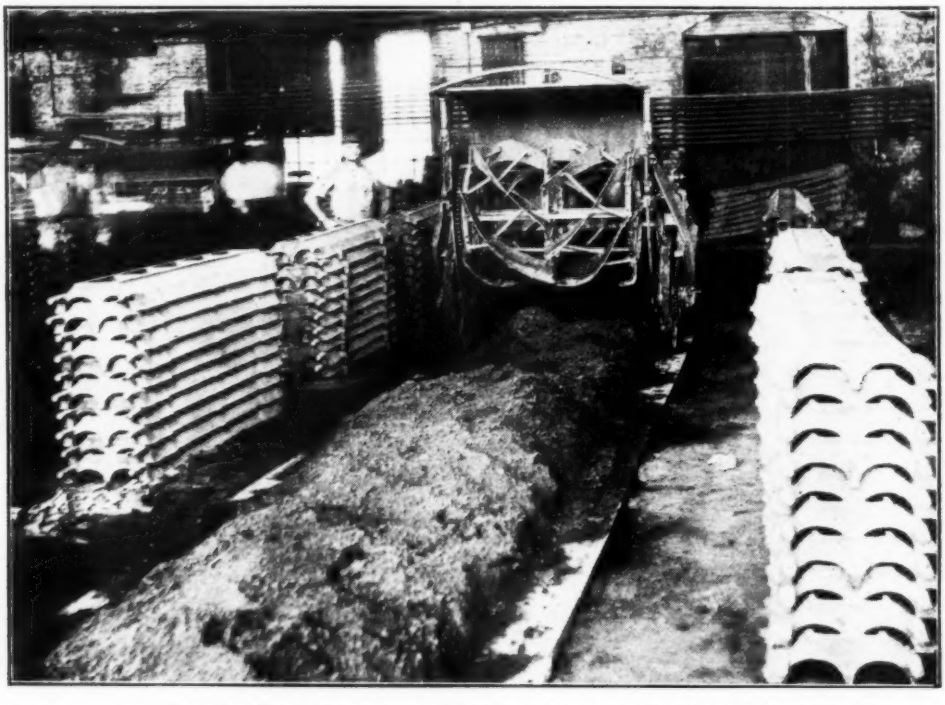


Fig. 8.—The Sand-Cutting Machine Shown in Fig. 7 at Work.

The Sand-Slinging Machine.

Another innovation seeks to avoid the use of a conveyor by taking the machine to the sand instead of conveying the sand to the machine, and incidentally employs an entirely new system of moulding. This machine, known as the "Sand-slinger," is of American origin, but is made in this country by the Foundry Plant and Machinery, Limited, of Glasgow. The sand-slinger travels into the sand heap under its own power, collecting the sand from the floor by means of a right- and left-hand sand-cutting screw conveyor, which delivers the sand to the centre of the machine, whence it is taken up by a bucket elevator, and deposited on the screen of an oscillatory riddle. The riddled sand, freed from scrap, gaggers, cores, etc., is conveyed by the riddle into a hopper mounted on the impeller arm, which in general appearance somewhat resembles the arm of a radial drilling machine. From this point a belt conveys the sand into the impeller head, which by centrifugal force discharges it into the mould at the rate of 10 cub. ft. of rammed sand per min. The action of the revolving blade in the impeller head in cutting through the sand discharged from the belt, and the centrifugal compression of the sand to form a wad, closely resembles the action of a moulder who throws handfuls of compressed sand into the deep partings or pockets of a difficult pattern. For large moulds the sand-slinger has a field entirely its own.

giving 9 tons of metal continuously for 8 hours a day. A power-operated charging machine is arranged between the two cupolas, a charge being deflected into one or other of the cupolas as desired by means of a swivelling chute at the top operated by chain from the ground. Trucks are provided which are loaded up in the stock-yard with a charge of metal and fuel, and are wheeled into the cradle of the charger, which elevates them and tips their contents direct into the cupola. The molten metal from the cupola runs into a fixed tipping ladle, from which it is transferred to casting ladles on a runway leading to the casting point. The runway is continuous, and the ladles travel in one direction, coming back empty on one side of the cupola and leaving full on the other. The casting ladles have a capacity of 10 cwts., and are readily pushed along the runway and poured by one man. Each ladle is sufficient for casting three moulds, and travels with the track while pouring. The blowing plant consists of two blowers, each driven by its own electric motor and capable of supplying one cupola with air.

The elliptical casting track consists of 64 tables at 4 ft. centres, each large enough to accommodate either bottom or top boxes. The track is 115 ft. long and 25 ft. wide. The tables are coupled together by continuous chains driven by sprocket wheels at four points underneath the track. Each sprocket wheel is driven by gearing from an elec-

tric motor, and the maximum speed of the track is 12 ft. per minute.

The moulding machines are arranged four outside and four inside the track, opposite each other for handling the bottom boxes, the remaining four outside the track for handling the top boxes. A pneumatic double-jib crane is provided at each moulding box to lift the rammed-up mould from the machine and the empty box from the track simultaneously, and by rotating the jib to replace them simultaneously in reversed positions.

The bottom boxes having been placed on the casting track arrive in front of the four machines moulding top boxes. These latter are placed in position on the bottom boxes as the track passes round the quarter-circle bend. The boxes are clamped together and the runner boxes attached. The moulds next arrive at the casting position, which is provided with the ladle runway. Each mould has a hook attachment which may be readily engaged and disengaged with the bracket arm of the casting ladle, which therefore moves on the runway at the same speed as the track during the operation of casting.

After casting, the moulds pass on to the knock-out point, where the top box is lifted off by the jib crane and deposited on the reciprocating grid of the first shaker, the bottom box being lifted off by the second jib crane and deposited on the reciprocating grid of the second shaker. The castings and boxes remain on these grids whilst the sand falls through the revivifier. The top box is then placed by hand on the table of the track immediately behind that from which it was lifted. The bottom box is replaced on the same table from which it was taken by the jib crane beyond the second shaker. The hot castings left on the grids are pulled off by hooked rakes, and finally deposited on the horizontal conveyor which runs continuously and removes them to the fettling shop. A gravity runway, with jib crane, at its lower extremity is provided to deal with bottom boxes which may have been detained too long at the knock-out point to enable them to be replaced on the track.

Sand-Treating Plant.

This consists of two revivifiers placed immediately below the shake-out grids, so that all the sand from the boxes is delivered into them. A spray of water damps the sand as it enters the revivifiers.

The disintegrated sand drops through the base of each machine, and by means of two chutes inclined towards each other falls on a horizontal conveyor which carries it underneath and towards the centre of the elliptical casting track. Here it is delivered into the foot of an inclined elevator, which carries it upwards above the track level and delivers it into the hopper of a radial trough. This deposits the sand in a semi-circular heap on the ground level, where it is turned over by hand labour and further damped down. The amount of sand to be handled is about 22 tons per hour.

A track is provided over each casting track to carry a two-ton 3-motor electric travelling crane. This is fitted with a 15 cub. ft. capacity grab bucket, which picks up the tempered sand from the floor, and deposits it in the hoppers arranged one over each moulding machine. Each hopper has a capacity of 15 cub. ft., equal to that of the grab bucket, and sufficient for three moulds. The crane has therefore to pick up one grab bucket full of sand every two minutes to maintain the maximum output of the casting unit, viz., 80 moulds per hour.

During maximum production the track will be in motion for 2½ mins., followed by a stop of ½ min., and so on. The top boxes will be placed in position on the top of the bottom boxes from the four machines producing them every time the track stops.

In conclusion, the author does not submit that the system just described can be carried out in its entirety except on a very large scale, and in a foundry engaged largely on repetition work. At the same time, he is of opinon that many of the points raised are capable of adoption in a modified form, or that they offer suggestions which may be applied with advantage, in general foundry practice. He believes that a study of these methods is calculated to lead to a great improvement in the appliances provided for the "mechanical handling of materials in the foundry."

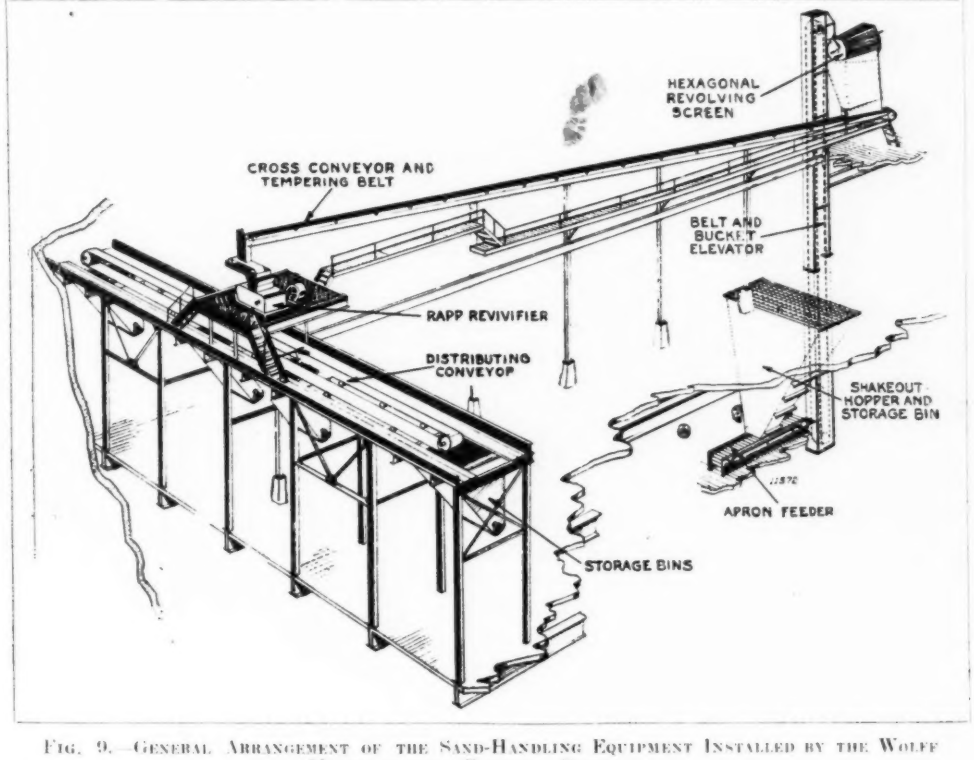


FIG. 9.—GENERAL ARRANGEMENT OF THE SAND-HANDLING EQUIPMENT INSTALLED BY THE WOLFF MANUFACTURING COMPANY, CHICAGO.

THE HILLFOOT FORGING COMPANY, LIMITED, have removed from Slack Steel Works, Penistone Road, Sheffield, to Wisewood, Malin Bridge, Sheffield.

The Evolution of the Foundryman.*

By W. H. Sherburn, M.I.Brit.F.

(*Continued from page* 136.)

Training of Juniors.

Another important factor in the evolution of the foundryman which demands careful consideration, and on which the future of the craft largely depends, is the selection and efficient training of the junior. Although the apprentice question has been much under discussion during recent years, it still remains in a very unsatisfactory and chaotic condition. Without being unduly sentimental, the author submits that modern business methods, be they ever so scientific, will lack the element of permanency and real efficiency unless they recognise and embody the spirit of human relationship between the individuals who make up the whole of the staff of each separate concern.

Of late years the link binding the youth learning a trade to the firm employing him has been as loose as that binding the adult worker, with the result that neither felt much responsibility to the other, and the trade or craft was generally very imperfectly learned. We all deplore the results of this, and would be glad to see it remedied. Many schemes for doing this are on paper, and many more are floating in mid-air. Any scheme, to have chance of adoption, must be simple, and must begin with things as they are.

How can we begin to put things right with the boys just entering our shops without derangement to business? Some of the schemes which have been formulated are as ingenious and elaborate as they are impracticable, and would have the effect of carrying the boy out of the foundry rather than making him wish to remain in it. It will be worth while to return to our germ, and see the small foundries in which the early craftsmen were made.

A Century Ago.

Although we cannot transfer those conditions in their simplicity to our own day—neither is it desirable—we may get hints which will be helpful in our consideration. The first feature we notice in the systems in vogue in the first half of the 19th Century gives us the key to the success in making fine craftsmen. That is the idea of "guardianship," and very frequently "foster parentage" of the employer towards his apprentices. This expressed itself in two or three ways: (1) Where the boys lived and worked with their employers and their assistants; (2) where the boy was apprenticed under indentures, signed by the employer, the boy and his father.

(1) In the best examples of the former type the employer took upon himself the responsibility of father to his apprentices, and his home was their home.

It was no uncommon thing in those days to see the apprentices, neatly dressed, walking in orderly file in front of their employer to church on Sunday mornings.

(2) The indenture at that time provided that the father bound himself to provide good lodgings, good food, and clothing for the boy during his apprenticeship, in consideration for the wages paid to him, not the boy, and if he failed to do so the employer must provide them otherwise, and use the wages for that purpose. The author has such an indenture in his possession, over 100 years old, in which his maternal grandfather was apprenticed to learn the art, mystery and occupation of an ironmoulder.

It is interesting to note that although the boy in question signed the indenture with a cross, he grew up to be a worthy craftsman and proud of his work.

Now while, from the point of view of the modern production engineer, these early methods are hopelessly out of date, and from the modern boy's point of view equally so, yet from the individual and the craftsman point of view, they contain hints which we should do well to consider with the purpose of recovering the link of human fellowship in work which was recognised at that time, and which seemed to make for a harmonious industrial organism such as, in spite of our present high state of development in some directions, we often now look for in vain.

There are many mistaken ideas abroad with respect to the education of boys and the best age at which they should begin work.

Our elementary educational methods have, until very recently, been hopelessly wrong and wasteful. A normal, healthy boy wants to be DOING THINGS very early, not simply poring over book lessons. Learning and doing must proceed together. Many a promising craftsman has been spoiled by being kept too long at school, and many a seemingly unlikely lad has grown skilful because he was obliged to begin work early. If we study either our own early days or the tendencies of the boys about us, we may gather hints as to the best training methods.

While the author is no advocate of unreasonable disarrangement of work to suit outside classes, he is convinced that the transfer of boys from the free life and short hours of school to the discipline, and sometimes drudgery, of the workshop is often too violent, and might with advantage be made more gradual, and therefore more natural.

Let the boy get familiar with the workshop early, and by gradual stages, and the chances are that he will eventually find his right place, and we shall not see so many misfits *as there are at present*.

James Nasmyth's Training.

In reading the autobiography of James Nasmyth, nothing stands out more forcibly than the way in which this delightful British craftsman received his youthful training. His nature and his opportunities were exceptional, and he did them credit. They illustrate the natural way of training which boys are generally eager to follow. His father being an artist, the lad learned to draw very early, and liked it, but the little mechanic's shop (his father's hobby) was the lad's paradise.

Making things, whether it was peg-tops for his chums, little cannon, flint and steel, balloons or kites, absorbed his young mind, and he was ever active, making something better than those to be obtained otherwise. He was fortunate in two playmates—for one the son of an ironfounder and the other of a chemist. He had the run of the foundry, and was delighted to work in the sand. He soon got chummy with several of the workmen, who, seeing the lad was so keen to learn, took delight in teaching him things. One, particularly, showed him how to harden and temper steel.

It is not surprising to learn that under such conditions he became more expert in practical mechanics before beginning to serve a short apprenticeship with Maudsley, the great mechanic, than most are after apprenticeship is completed.

The wisdom he gathered from all these boyish observations was well expressed by him afterwards by the following platitudes:—"The truth is that the eyes and the fingers—the bare fingers—are the principal inlets to sound practical instruction.

"They are the chief sources of trustworthy knowledge as to all the materials and operations which the engineer has to deal with.

"No book knowledge can avail for that purpose.

"The nature and properties of the materials must come in through the finger-ends.

"Hence, I have no faith in young engineers who are addicted to wearing gloves. Gloves, especially kid gloves, are perfect *non-conductors of technical knowledge*."

When he became an employer and had apprentices, he quite naturally had definite ideas as to their training.

While he had a few premium apprentices (more to please friends than himself), he found they gave constant trouble and little satisfaction. He greatly preferred to employ intelligent young sons of workmen under a quite free arrangement, who

* A Paper presented to the Lancashire Branch of the Institution of British Foundrymen, Mr. John Haigh in the chair.

were encouraged to make progress, and were advanced in work and wages accordingly. His views on this question are:—"They vied with each other in executing their work with precision. The only bond of union between us was mutual interest. They were desirous of retaining those they had trained, and the best of the boys desired to remain because they were pleased with their work and surroundings. Nothing could have been more satisfactory than the manner this system worked."

What of the Future?

All this happened over eighty years ago. How far have we travelled in these particulars in the interval? Obviously, not very far!

There is no need to repeat the many conflicting proposals for dealing with the future foundryman which have recently been put forward. They are fresh in everyone's minds. Some of them fall short through confused ideas as to education; what it really is and how it is best obtained. The ideal education of a craftsman is to be gained as Nasmyth gained his—eyes, memory, and fingers co-operating together. Education has no set time or place; it is a perpetual process, and every place is a school.

The school as we know it is not always the best seat of education for a boy after 14 years of age, especially when the boy's mind is not there. A knowledge of drawing is as important to the future of many boys as that of writing. It is a universal language.

Not very long ago, illustrated books and magazines were rare, and cinemas were unknown. Books were chiefly plain reading, and usually dry work. To-day we are educated by pictures. How clearly a sketch of a few lines may explain an idea! Hence its importance, and yet, how few there are who can make a fair sketch! For most boys of 14 years of age, it can be stated that the workshop is a better place of education than the day school. A voluntary combination is, of course, much better still. That the average modern workshop conditions are open to improvement from the point of view of a training ground for juniors, goes without saying. We all agree on that point, and are doing our best to quicken the process of improvement.

The result of the author's reflection on the problem is that every industrial concern ought to be a complete organism or an enlarged family. The boys engaged in the concern should be looked upon by the adults in closest touch with them as, for the time being, *their own boys*, and although, in a large concern, such duties must perforce be delegated by the management in this way, the employers would recognise the "over-parentage" of their position in virtue of control and responsibility, and they would grow proud of it. On such a natural foundation the management would see to it that boys entering their service should have the opportunity to grow naturally into their new surroundings, have fair chances for learning and advancement, and be encouraged to learn in their free time, which would be ample, those kindred subjects which would enable them to fill the responsible positions adequately in due course.

No attempt should be made to force the boys either to attend classes or to do too much drudgery in the workshop, by which latter many a promising lad has been disheartened in the past. Given a fair opportunity, the average healthy-minded boy will make headway. *Carry him about, or force him, and he is spoilt.* Ours to provide the opportunity, his to take advantage of it. Under such conditions, Nasmyth's plan of free service, bound only by mutual interest and respect, would be quite satisfactory. Willing service is good service.

The New Spirit.

The spirit of mutual fellowship in service which laid the foundations of our craft, and made laborious and uncomfortable work attractive and full of interest, can do the same in the larger combination if entered into with the same goodwill and mutual respect. "We are all in the same boat"—a truism in war-time is not an atom less true of our craft to-day. That an increasing number of our captains of industry realise this fact, and are using their influence in the right direction, *is as hopeful as it is true.*

Having put before you a few thoughts on the evolution of the foundryman, and having drawn attention to the dangers of lop-sided development, is it not possible, and is it not reasonable, to expect that the power which has brought industrial organisms to such a high state of efficiency, which has equipped them with all the marvellous devices of service, may, by exercise of the same foresight and understanding (plus the New Spirit), complete the development of those branches which are still incomplete and which, by their neglect, are giving so much discomfort to the community?

There is little wrong with the form of our industrial organisations, except what a new spirit in their administration could easily correct. The new incentive of service in place of self would make it possible so to shape the future evolution of industry as to ensure harmonious working on lines as sure as those of the solar system.

No apology is necessary—neither is it offered—in leaving the beaten track of ordinary subjects of discussion. The Institution is out to make foundrymen both specialists and all-round men, fully developed in body and mind. Each member should bring his quota of experience to the pool. One may bring organisation, another practical experience, another the fruit of research, and others the atmosphere. Each according to the bent of his mind or the appeal of the problem. In the choice of subjects for discussion, the foundry has naturally made the widest appeal for attention, and has got it. It provides so many interesting problems. The "foundry-*man*" has come *after*—sometimes in presidential addresses, and sometimes at dinners.

With the exception of design and patterns, the "*foundryman*" has appealed most strongly to the author, and he has obtained *much interest out of him;* hence his choice for a subject. In the final balance he is the key to the whole problem.

The near future will pay more attention to the "man" and the "boy," and when they are brought in harmony with the material organisation, other problems can receive more whole-hearted attention, and progress will be more rapid.

Is it foolish to believe that we are now slowly evolving from the mammon stage to the stage of common service? When the captains of industry, so able in organisation, will set out to conduct the various industries of the nation with the same high purpose as the statesman, the general, the doctor, or the clergyman, for the good of the commonwealth—a consummation devoutly to be wished! By so doing, they would fulfil in the noblest manner the high purpose of existence. This is a goal worth keeping in view.

From the above naturally arise:—(1) How to awaken interest in craft? (2) How to promote fellowship in the foundry, with a view to awakening interest? (3) How to interest youths in foundry work and ensure their thorough training? Many have given serious thought to some of these problems, and it is to be hoped that some will give free expression to the conclusions formed, so that we may, if possible, carry the questions a step nearer solution.

A clever and idealistic modern craftsman, Mr. T. J. Cobden-Sanderson, a bookbinder, puts the case for the higher direction of industry so well that it is well worth consideration:—"Think of man's discoveries in the domain of knowledge. Think of his astonishing inventions and material works of all kinds, and of the boundless energy wherewith they have been carried through and applied. Think of the marvellous modes of locomotion and communication—railroads, steamships and telegraphs—and then ask, cannot man ever *aim* at like victories in the moral field? Can he not, so much as *aim* at their mastery? And at their direction, to the making of the greatest work of art ever yet dreamed of by man, the creation of a worldwide human society, *based upon industrialism*, properly directed and properly shared, having for its sweet flowerage beauty, and endowed with all the moral and social energies requisite for its construction and for its maintenance? I say yes, and add that not only must industrialism be so transfigured and become a work of art, but so must science also, even pure knowledge science, the attempt to understand, to take in, to apprehend the Universe."

An Apprenticeship Course in Foundry Practice.—XXXII.

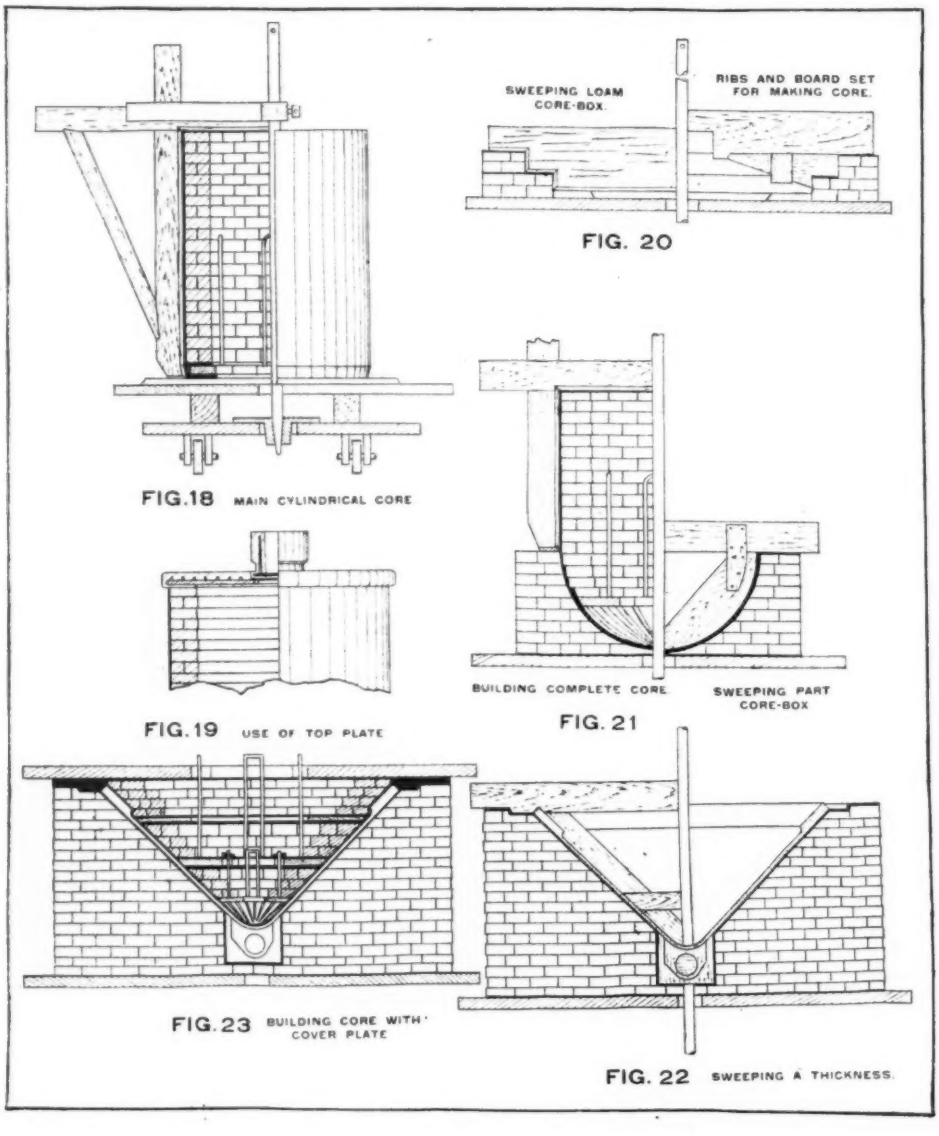
By Ben Shaw and James Edgar.

LOAM MOULDING.

Part IV.

Sweeping Cores about a Vertical Spindle.

The use of sweeping boards attached to and rotated about a vertical spindle has a very special economic value in the making of cylindrical cores. Vertical sweeping is more commonly employed for making cores than for making moulds or loam patterns, and there are several reasons for this. The diameter and height of the work to be made and the number of castings required have a considerable influence on whether a mould will be swept or not. Thus a cylindrical body of less than 3 ft. in diameter and about 4 ft. or 5 ft. high is not likely to have its mould swept out because little room is afforded for doing the work satisfactorily. A loam pattern may be swept up in such cases to which other pattern sections in wood can be attached. The mould can then be made either in dry sand or loam. In many instances, however, the subsidiary wood pattern sections that would need to be attached to a loam pattern of this description are of such a character that they almost cover the swept work. An intermediate cylinder can be cited as an example of such work. In such cases it is frequently more economical to make a full wood pattern, even if only one casting is required, whereas when many castings are required, it is rarely indeed that other than a full pattern is supplied. But although there are a variety of methods used in forming the moulds for cylindrical castings, it is only in the case of small work that core-boxes are supplied for the making of cylindrical cores; they are invariably swept, not only because it is the more economical method, but because they are more conveniently swept than made in a box.


SWEEPING LOAM CORE-BOX.
RIBS AND BOARD SET FOR MAKING CORE.
FIG. 20
FIG. 18 MAIN CYLINDRICAL CORE
FIG. 19 USE OF TOP PLATE
BUILDING COMPLETE CORE.
SWEEPING PART CORE-BOX
FIG. 21
FIG. 23 BUILDING CORE WITH COVER PLATE
FIG. 22 SWEEPING A THICKNESS.

Many methods are at the disposal of the loam moulder in producing cores each having their own particular sphere of usefulness. Thus cores may be swept direct at one operation, and this method covers the majority of cylindrical cores. In many instances, however, it is necessary to sweep a seating or, what may be more properly termed, a loam core-box, or a thickness may be swept on the mould representing the thickness of metal, against which the core can be built. These two latter methods are capable of wide application and are frequently necessary to overcome difficulties that would otherwise be very real.

Sweeping Cores Direct.

In the majority of instances cores that are swept on a plate must be lifted after they have been dried and blacked to be lowered into their respective moulds. Thus the building plate is merely a support for a core during the time it is being prepared. In some instances, however, the building plate is part of the mould, and it is used for the core after the mould has been prepared and lifted for blackening. This method is sometimes used when the mould is of loam, and when it is profitable to lower the cope over the core. Even in such instances, however, it is usually better to make the core on a separate plate, so that it can be lifted and located on the bottom plate of the mould, and then the making of the mould and core can proceed at the same time. With few exceptions, therefore, a lifting plate must be introduced into swept cores to give the necessary facilities for lifting them into their moulds. This plate becomes part of the core, and besides being strong enough to support the weight of material used in forming the core, it is required to have internal staples cast in it of convenient height to render the operation of slinging comparatively easy and free from risk. The first operation in the making of a large cylindrical core about a vertical spindle is to prepare a lifting plate and provide a building plate with a level bearance. Usually, the latter is dried before being used for the core, but when the work is urgent the core may be built upon a green bearance, if the loam has been allowed to stiffen. Generally, in fixing the core board to the spindle, the bottom is allowed to touch the bearance, but when the bearance is green it is better to keep the board about 1-16th in. clear. Many moulders lift the board clear of the bearance whether it is green or not, contending that a loam-core sags and compensates for the increased height. The necessity for this depends largely on the condition of the floor, over which the bogie has to travel when conveying the core to the oven, but, if at all possible, the built-up core should be allowed to stand, in order that the loam will become stiff before the final sweeping is done. If this method is adhered to, there is little likelihood of sagging, especially if conveyor tracks are used for the bogie. Obviously, even this method cannot be relied upon to prevent sagging if the bogie is subject to much jolting through unevenness of the floor.

The lifting plate should be bedded into loam applied to the bearance before the board is fixed to the spindle, its correct position being located after the board has been rotated. All plates and grids used should be daubed with claywash to give the loam a firmer hold. The building of loam and bricks upon the lifting plates follows on similar lines to those previously explained, excepting that greater care is necessary in building, avoiding open spaces between the bricks and making the thickness of the brick wall strong enough to withstand the pressure of the metal. When the full diameter of the core is to pass through the metal, it is not necessary to use a top plate on the core, and its formation would be similar to that illustrated in Fig 18, but when any considerable part of the top is to be covered with metal, a top plate is essential. The use of a top plate is illustrated in Fig. 19, which shows the top part of a centre core for a cylinder. Sometimes the stuffing box core and the centre core can be swept at one operation, but usually a print is swept in the centre core to receive a loose stuffing box core. Whichever method may be adopted involves the use of a top plate to give the requisite strength to the top of the core. In the instance illustrated, it is advisable to make the centre hole through the plate as large as is permissible for venting purposes. Sometimes centre cores of this character are lightly rammed with sand inside the brickwork and after they have been located in their moulds. This is done with the idea of reducing the air volume inside the core under the influence of the high temperature during the time of casting, and one of the reasons for making a separate stuffing-box core is to give better access to the inside of the centre core for the purpose of introducing sand.

Sweeping Core-Boxes or Seatings.

The most important reason for preparing a shape on or in which a core can be made is really to reduce the necessity for inverting cores. Thus many cores can be swept direct, but they would need to be turned over to suit the mould, a proceeding which would involve considerable additional tackle and greater risk, even if it were possible. By preparing a core-box or seating, therefore, the core can be made in such a position that it coincides with the position that it is to occupy in the mould. A simple illustration is that necessary for the core required for the centralising casting previously referred to and shown in Fig. 20. In this case a part core-box is swept in which the ribs are located and the core built, a board attached to the spindle being used to complete the top shape. In large, shallow cores of this kind it may not be necessary to use bricks, loam being used solely, though dried loam will be advantageously employed to stiffen the work during the process of building. A claywashed grid should be bedded into a covering of loam on the bottom of the core-box. It is usual in cases of this kind to cut a recess in each rib to allow for the use of a continuous grid, the small parts of the grid which pass through the ribs being cast with the job eventually and becoming part of the casting. The core-box is retained until the core is dried, and if no more cores are required to be made from it, it can be dispensed with.

Another kind of core for which a swept core-box is suitable, differing only in form from the previous instance, is the centre core for the suction chamber. Fig. 21 illustrates the procedure in the preparation of this core. The spherical end only is swept out, giving an impression for part of the required core, the remainder being swept direct by means of the board shown. In this instance the core has to be suspended from the top and a print is swept on to correspond with the recess formed in the cover, but provision must be made for securing the core to the cover. For this purpose the plate or grid used to carry the core should have suitable staples cast in for engaging hook bolts. The core plate in this case cannot be located at the bottom of the core; it must therefore have suitable gaggers cast on or bits of wrought iron cast in it in order to carry the loam forming the spherical end. Curved gaggers are easily formed when making the plate, but they are not easily formed to follow a definite shape. They can, of course, be easily broken off if they are irregular, but when wrought iron is used, the pieces can afterwards be bent to suit the shape, therefore for work of this kind pieces of iron cast with the plate are recommended for carrying the bottom part of the core.

Although only two examples of core-box sweeping have been considered, they will suffice to show the principle on which many cylindrical cores are made. The method, however, is capable of wide variation to suit the work to be done. It can, for instance, be used for providing a shaped bearance on which sectional cores can be built, when only two or three such cores are prepared at one time, instead of the full number required for the job. This method is sometimes a necessity owing to the size of the work occupying so much room, and any method that reduces the working space of a job, say 7 ft. dia., such as a large rotor which would have in all probability the cope, cores and cover prepared on the same floor, gives additional room for other necessary work.

When a loam core-box is prepared in this way, and a few cores are to be made from it, the first core should not be built until the box has been dried, but for ordinary one-off jobs, if the loam is allowed to stiffen, the core can be made in it quite satisfactorily without it being thoroughly dried. It is necessary, of course, to dust with parting sand before the loam is applied to the core-box.

Thicknessing to Form Core-Box.

As a general rule it is more economical in time, when it is possible, for the mould and core to be made separately, as the formation of each can proceed simultaneously. This does not mean that this method is necessarily the cheapest, but that more men are capable of being profitably employed on the job and both mould and core should be built and swept in one day ready for stoving at night. But unless the work is comparatively

small, the large amount of floor and drying space such a method would involve must be considered. Instead of sweeping the core separately, a thickness of sand or loam may be swept on the mould corresponding to the thickness of metal required in the casting and following the internal shape. This provides a core-box in which the desired core can be built. The use of one board combining the two functions, that is, of sweeping both mould and thickness, is advantageous, not so much because of the saving of material and labour in making the board, but because the strip secured to the working edge can be removed after the mould has been swept, and the board is then ready for sweeping the thickness. There is not the difficulty that would be experienced in setting a separate board to obtain the requisite thickness.

This method of applying a thickness to a mould can be profitably applied in the making of the bell casting referred to in a previous article. In this instance the core and cover can be made as one, and it is the most convenient way. The method of sweeping the thickness is shown in Fig. 22, and the formation of the cover carrying the core is shown in Fig. 23. The mould is prepared similarly to those described in the last article, and it should be allowed to stiffen before the thickness is applied. When the mould is sufficiently dry and the strip has been removed from the board, a dusting of parting sand is given and the thickness of loam swept. Then, with the wood section at the bottom, this thickness of loam provides a complete, though temporary, pattern from which the remaining part of the mould can be satisfactorily formed. Owing to the shape of the casting, it is necessary to strengthen the core at intervals with building rings. It will be noticed that the bottom plate, which carries gaggers on the underside, is secured to the main or lifting plate. This method gives better lifting facilities. The staples may be carried through the cover plate, or hook bolts may be used to secure the structure to the cover plate. When the cover has been made as depicted in Fig. 23, the whole is stoved, and when dry, the cover can be lifted and the temporary thickness of loam removed preparatory to the application of a facing wash.

This method is also applicable to a wide variety of jobs, and its utility is not confined to loam moulding. Many other examples of work suitable for sweeping about a vertical spindle could be described, but they would conform more or less to the more general methods which have been described.

Annealing Gray Cast Iron.*

By J. F. HARPER AND R. S. MACPHERRAN.

The investigation discussed in this paper was conducted by the Allis-Chalmers Manufacturing Company, in order to determine the correct time and temperature for annealing grey iron castings, as well as to determine the effect of annealing and quenching on the physical properties. Each set of test bars was cast from the same 3,000-lb. ladle, five transverse bars, 1 × 2 × 26 in., being cast in each flask. When breaking several bars at a given temperature, only one bar was taken from any one flask. This was done to average the casting conditions.

Brinell and Scleroscope tests were made on a ground surface of transverse bars near the fracture or on a ground surface of the threaded end of the test bar when only tensile bars were broken.

The transverse bars were 1 × 2 in. and 24 in. between centres, and were broken on a standard Riehle-type transverse testing machine. The tensile bars were cut from transverse bars after fracture, and were taken longitudinally, and adjacent to the fracture. The tensile bars were made with threaded ends, and were ground to 0.564 in. for a space of 2 in. in the centre of the bar.

The furnace used for heating was of the semi-muffle oil-fired type and was equipped with a Leeds and Northrup-type potentiometer pyrometer system. For annealing purposes test bars were held at the maximum temperature for one hour, and cooled in the furnace. The combined carbon was determined by colour and only used as a check.

The results of annealing for one hour on the first set of bars would indicate that up to 620 deg. C., there has been no loss of strength. Apparently there is a slight drop in the Scleroscope hardness, but no change in the Brinell hardness until 650 deg. C., is passed. These results are confirmed by the change in combined carbon.

It was noted that no decided change had taken place until temperature of 675 deg. C. was reached. This change is progressive as temperature increases until at 815 deg. C. it is practically complete. There also appeared to be a tendency of the graphite flakes to enlarge.

The results of annealing for a period of one hour indicated no loss of strength at 620 deg. C. nor material decrease in Brinell and Scleroscope hardness at this temperature.

At 675 deg. C. there is a slight drop in physical properties, as well as in hardness. These results are again confirmed by a decrease in combined carbon.

From the tests made, it would appear that the temperature of 620 deg. C. (for one hour) should not be exceeded when annealing to relieve machine or casting strains. The effect of continued annealing at this temperature showed that there was a material loss of hardness and strength on the longer periods of time at this temperature.

The effect of annealing at 565 deg. C. for various periods of time, indicates that this temperature for reasonable periods, does not tend to decrease materially the hardness or strength.

When annealing to increase machineability, only temperatures of from 785 to 840 deg. C. will be found satisfactory. In this case, however, there was found a drop in hardness accompanied by a decided loss of strength.

The bars were held at the quenching temperature for one hour before quenching in water. Above 680 deg. C. the Brinell hardness falls off until 760 deg. C. is reached, above which it rises very rapidly. The fall in Scleroscope hardness is less abrupt, but both decline and increase follows the Brinell test. The tensile strength falls off above 620 deg. progressively until 760 deg. is reached. When quenched above this temperature the bars were too hard to machine. The combined carbon begins to diminish at 650 deg., which change continues progressively until over 760 deg., when it again rises rapidly.

The test bars were cut from the broken transverse bars no bar being heated for these tests to a higher temperature than was given it in the tests.

In comparing results close agreement was found between the properties of the bars in this research heated to the same temperature. This agreement continues up to 760 deg. C. Above which temperature the carbon in the quenched bars seems to be partly dissolved and held in this condition by the quenching with a consequent increase in hardness.

When the test bars were cut from other broken transverse bars and were quenched in water after holding at quenching temperature one hour, it was found that above 650 deg. C. the Brinell hardness falls off until 760 deg. C. is reached, above which it increases rapidly. The change in Scleroscope hardness again follows the Brinell test. The tensile strength begins to show a decrease at 650 deg. which continues until 760 deg. is reached. When quenched above this temperature the bars become unmachineable. The combined carbon seems to confirm the above tests.

Micrographs show a breaking up of the carbides at temperatures above 650 deg. C., which change is practically complete at 760 deg. C. When quenched above this temperature the carbon is partly retained in solution with resulting increase in hardness.

From the results of these tests it would seem that until the temperature exceeds the critical the rate of cooling has no effect on the physical properties of cast iron.

* Abstract of a Paper presented before the Rochester Meeting of the American Foundrymen's Association.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, Falcon Works, Loughborough, have removed their London office and registered office to 88, Kingsway, W.C.2.

Institution of British Foundrymen.

NEWCASTLE BRANCH.

Annual Dinner.

The annual dinner of the Newcastle Branch of the Institution of British Foundrymen was held at the County Hotel, Newcastle, on January 27, and proved a very successful and enjoyable affair. The chair was occupied by the Branch President, Mr. H. J. Young, F.I.C., and the large company present included the Lord Mayor of Newcastle, Alderman William Bramble; Mr. H. L. Reason, President of the Institution; Mr. R. O. Patterson, Vice-President of the Institution; Mr. S. W. Wise and Mr. J. W. Frier, Vice-Presidents; Mr. R. Wallis, Mr. V. C. Faulkner, London, and many others.

MR. J. W. FRIER proposed "Our Guests," and recalled the fact that that was the first time they had been honoured by having the Lord Mayor present at their annual dinner. He also personally welcomed their President and Mr. Faulkner, the Editor of the FOUNDRY TRADE JOURNAL. He had had the pleasure of hearing him at the Birmingham Conference, and his racy remarks when he was interpreting a Paper given by one of their Continental friends were a real treat. To their guests they looked for help to rise from that lowly position which they had occupied in the past to that position to which they, as foundrymen, were justly entitled in the engineering world.

MR. V. C. FAULKNER, in the unavoidable absence of Commander Hawkes, of Armstrong College, replied to the toast. After recounting a few funny stories, Mr. Faulkner briefly referred to the forthcoming International Conference, to open in Paris on September 11. They had formed a sub-committee, mostly of Londoners, to arrange the details of the trip, but he did not want any of them to think that they were being neglected, for in the formation of that sub-committee they had been specially careful to see that every member of the committee would be invited to the meetings of the sub-committee and kept *au fait* with what they were doing. Mr. Young, as a member of the committee, would, therefore, be in a position to keep the Newcastle Branch posted in regard to the Congress, because everybody wished to make a distinct success of the undertaking and they hoped they would get quite a crowd from that city to go to Paris. Referring briefly to trade prospects, Mr. Faulkner said he was glad to tell them that only three and a half per cent. of brass workers were out of work at the moment. That was quite a good augury. Latest advices showed that some foundries in the London and Scottish districts were really busy, and he hoped Newcastle's trade would show some improvement on the past year. He thanked them all very cordially for the typical Tyneside welcome which they had given the guests that night.

"The Industries of the North-East Coast" were next proposed by MR. ROBERT WALLIS, a toast which, he said, could be easily summed up in the words, "may the glories of the past be the glories of the future." The North-East Coast had been bound up in the progress of the nation, and only to mention a few of the names that had made history—Stephenson, Armstrong, Swan, Parsons—those names were wrapped up in the history of the industry of Great Britain. If the future would bring forward men of the same outstanding characteristics as those he had mentioned, then the future of the industries of that district was assured.

THE LORD MAYOR (Ald. William Bramble), in reply, said he was glad to be present to give them the civic blessing which some gatherings so much coveted. He regarded it as the business of a municipality to encourage gatherings of that description, for the social side of life ought never to be neglected, because by bringing men together they had opportunities of seeing one another in a different aspect from what they saw in the daily walk of life. It gave them opportunities of discussing questions in a different atmosphere from what they did in the ordinary course of events. Now, in regard to the toast, he believed a municipality could do a great deal to either make or mar the progress of industry, and one thing that was very important at the present time was the question of rates. If the rates of a district got out of proportion to the ability to support them, then trade could not be sustained. He had great hopes that this year would bring about a better state of things than what existed last year, but it all depended very largely upon themselves. Industry could only be expected to thrive when it was directed by the brains of those who were best equipped and adapted to carry it on. They had competition to deal with, and a question which they all ought to consider was State education of the industry in which they were engaged. A great deal was said some years ago about a certain country on the Continent, that they were making great strides because of their technical education. Well, there was nothing to stop Englishmen, and Tynesiders in particular, from adapting themselves to the situation and meeting that competition in the same form. The city of Newcastle spent more than a quarter of a million annually on education, and he hoped and trusted out of the money that was spent and the time devoted to the subject they would see good results that would help them to sustain trade.

MR. R. O. PATTERSON proposed "Our Institution" and observed that the progress that they had made when they recalled that their Branch was only about eighteen years of age was something enormous. When one remembered the secrecy and jealousy that formerly characterised their industry it made one's hair curl. He remembered the time when the secrets of the foundry were regarded with the utmost jealousy, and the result was continual strife between the foundries. Things had now changed, however, and the knowledge they had gained was of incalculable benefit to their industry. The junior branch which they had recently formed held out great possibilities. If they could get their boys to join he was sure in years to come they would produce a superior class of workmen to what they had in the foundry at the present time.

Progress of the Institution.

THE PRESIDENT (Mr. Reason), responding to the toast, said how pleased he was to be able to visit the Newcastle Branch, for there was no one who had a greater appreciation of Tyneside hospitality than himself. In connection with the dinner of the Scottish Branch he had taken the opportunity of visiting Mr. Mayer at Dumbarton [since deceased], to whom they were indebted for the magnificent Presidential chain of office. The years were now beginning to press heavily upon Mr. Mayer, and when he told him that he was going to Newcastle, he said, "Tell the boys that I should love to be with them, and give them my best wishes." The Institution looked upon the Newcastle Branch as one of the bulwarks of the Institution. They had a first-class membership, an excellent lecture room, and an excellent secretary. In fact, the Institution could not boast of a better secretary than Mr. Rang. Although they had a fine line of Branch Presidents, up to the present they had not produced a national President, and in that connection he regretted the absence of Mr. Edward Smith, for he was the gentleman they had their eye on as a future President. They also looked forward with a great deal of enthusiasm to the time when Mr. Patterson would occupy the position which he now held.

During the past year they had had unprecedented bad trade, and he hoped they would never have another like it. They had elected 107 members, 115 associate members, 29 associates and 19 subscribing firms. They had nearly 2,000 members, but had it not been for the bad year which they had experienced the membership would now have been nearly 4,000. They had to remember there were 5,000 foundries in the country, and it was quite within the bounds of possibility that they would soon have a membership of 5,000. In order to attract members they proposed to have a membership certificate, of which every member could obtain a copy to show

that he was a member of the Institution. That was important, because when employers were looking for men to fill responsible positions he felt that in future one of the qualifications would be, "Are you a member of the Institution of British Foundrymen?" He appealed to them all to do their best to make the 1923 Convention a real success. The Institution had done a great work of which they had every reason to be proud, but they had a greater work in front of them, and as an indication of the valuable work they were doing he mentioned that they now had a committee at work on the important and complex question of test bars. He hoped the foundry industry would rise to the occasion and help this country to keep its place in the forefront of the manufacturing nations of the world.

On the motion of Mr. S. W. Wise, "The Newcastle Branch and its President" was cordially toasted and Mr. Young suitably responded.

During the evening a programme of music was contributed by Mr. C. Burcham's concert party.

WEST RIDINGS OF YORKSHIRE BRANCH.

At a meeting held in the Technical College, Bradford, on January 13, Mr. A. A. Liardet, Branch-President, in the chair, it was announced that Prof. E. L. Rhead had been taken ill and was unable to be present to deliver his lecture on "The Foundry Cupola." As Prof. Rhead had wired only the previous day, the President had no opportunity to cancel the meeting.

Under the circumstances, said the President, someone had to fill the breach, and he was pleased to state that Mr. Love (Branch-Secretary) had agreed to do so.

Prof. Rhead's paper was not available, but the subject chosen created an excellent discussion to which more than a dozen members contributed. It lasted an hour and a-half, and the meeting proved to be one of the most enjoyable held this session. In addition to the vote of thanks to Mr. Love, a resolution was carried expressing the regret at the illness of Prof. Rhead, and trusting that he would soon be restored to health and that he would be able to fulfil his engagement at a future date. The meeting was attended by over 100 members and friends.

The Services of Henry Clifton Sorby to Metallurgy.

This was the title which Dr. Desch chose for his second "Sorby Lecture." It was delivered last October, and can now be obtained for one shilling from Mr. E. J. Thackeray, at the Department of Applied Science (The University), Mappin Street, Sheffield. We have previously outlined Sorby's work on which the basis of modern metallurgy rests. His work is being commemorated by an annual lecture, but for this purpose additional funds are required. Details of the appeal are available on request from Mr. Thackeray.

Book Review.

"Optical Methods in Control and Research Laboratories," by J. N. Goldsmith, S. J. Lewis, and F. Twyman. Published by Messrs. Adam Hilger, Limited, 75A, Camden Road, London, N.W.1. Price 1s. 8d., post free. This little book is divided in four sections, dealing consecutively with Metallurgical and Analytical Appliances, Absorption Spectra and Spectrophotometry, the Refractometer, and the Polarimeter. The spectroscope used to be employed considerably in connection with the Bessemer process, and we suggest to our readers that some interesting work could be done in connection with cupola practice. It should find many readers amongst foundrymen.

At the Cargo Fleet Ironworks an additional blast furnace has just been re-started on basic iron. Within the next week or so another blast furnace will be re-lighted at the Skinningrove Ironworks.

A New Case-Hardening Method.

By Frank Hodson.

A process which promises to improve considerably present methods of case-hardening has recently been introduced and patented by the Swedish engineer, Dr. Assar Gronwall, who will be remembered as the inventor of the Elektrometall type of electric shaft ore smelting furnace. Dr. Gronwall showed the writer a number of examples of this new case-hardening method, and he also had the privilege of examining records of tests made by Prof. Arnd Johansson, of the Techniska Hogskolan, Stockholm.

Dr. Gronwall's process is based upon the knowledge that carbonising is due to the presence of carbon monoxide, which, in the presence of iron at suitable temperatures, breaks up into carbonic acid and carbon, which, together with the iron, forms carbide of iron. In order to facilitate the process it is usual to mix with the carbonaceous packing a so-called carbonising powder, such as quartz, brick-dust, carbonate of barium, metallic oxides, etc., which are supposed to facilitate the formation of carbon monoxide within the furnace. It has been fully proved, however, that even when using the best cementing media the process is unnecessarily slow, and that deep carbonisation is very difficult. Dr. Gronwall's experiments proved that the gases enclosed in the case-hardening pots soon becomes saturated with carbonic acid, and therefore the process gradually stops.

The new method consists of converting the carbonic acid as formed to carbon monoxide. This is done by putting catalysers of a special metal in the form of thin sheets, ribbons or wires into the box with the carbonaceous matter surrounding the material to be case-hardened. The catalyser then acts in such a way that the carbonic acid, when coming in contact with the metal, passes into carbon monoxide. An iron object may be case-hardened deeper on a certain spot by placing the catalyser there. In the case of gear wheels they were case-hardened only on the outer parts of the cogs. The catalyser is not consumed during the operation, and therefore the expense for the new method consists only of the expense of original catalysers and the licence to operate.

With the new method less carbonising material is claimed to be needed, the temperature can be kept lower than in the usual method, and the time occupied is just about half. The tests at the technical academy, Stockholm, consisted in treating pieces of steel from the same bar in an electrically-heated furnace, first in the usual case-hardening method and second with the addition of the catalyser. The amount of case-hardening was considerably deeper in the second samples, although time occupied, temperature and other conditions were exactly the same.—"Iron Age."

Iron Ore Mines of Brittany.—The following particulars regarding the iron ore mines in the Chateaubriant Basin have been furnished by the Engineer of Mines at Nantes to the British Consul in that place: The external equipment of the Segré mines and their internal construction has been completed. The modern plant renders it possible to exploit both the Bois and Aulnais concessions, and to extract, at two points, a total of 1,500 tons of ore daily, or about 450,000 tons per annum. At the present time these mines are able to satisfy the requirements of the industries of the Lower Loire, which amount to 18,000 tons per month, and can furnish 15,000 to 20,000 tons of ore per month. Latterly the ore exported has gone to Germany, but negotiations have been entered into with British works for its utilisation, which appear likely to have a satisfactory outcome. The Segré ore contains, on an average, 52 per cent. iron and 12 per cent. silica. The external equipment of the Teillay mines and preliminary internal construction work are actively going forward. The production in 1923 will reach about 100,000 tons, and in 1924 it may be expected to rise to 200,000 tons. It is not thought likely that the latter figure will be increased in the following years, but the equipment is so designed as to be capable of easy expansion in case of need. The ore extracted is for the most part available for export. It contains, on an average, 53 per cent. of iron and 11 per cent. of silica. A large part of the deposit has been prospected, and is estimated to contain 20,000,000 tons of marketable ore.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS (MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

Trade Talk.

Dieny & Lucas, 329, High Holborn, London, W.C.1, have removed to 72, Victoria Street, S.W.1.

R. W. Cousins & Company, 1, Northampton Place, Swansea, have removed to 61, Wind Street, Swansea.

A fire broke out at the Monk Bridge Ironworks, Leeds, on February 16, but the damage was only slight.

Mr. James Anderson delivered a lecture on "Ball Bearings" at a meeting of the Scottish Engineers' Association held in Glasgow on February 15.

In connection with the Women's Engineering Society it is announced that a conference of women engineers will be held in Birmingham in April.

The South Wales & Lincolnshire Steel Products, Limited, have removed from 47/51, King William Street, E.C.4, to Caxton House, Westminster, S.W.1.

On inquiry we learn that nothing whatever is known to justify the rumour of an approaching amalgamation between Babcock & Wilcox, Limited, and Stewarts & Lloyds, Limited.

The noteholders of W. H. Dorman & Company, Limited, have now agreed to the resolution providing for an exchange of the 8 per cent. participating 7-year notes of the company into debentures.

A. F. Bundy & Company, 31, High Holborn, London, W.C.1, have been appointed sole British agents for the Bayer soot blower, manufactured by the Bayer Company, of St. Louis, U.S.A.

James Howden & Company, Limited, Glasgow, have received an order for two turbo-alternators of 5,000 k.w. each and one of 1,000 k.w., to be used in the power plant of the Winnipeg Municipality.

Work was resumed in all the steel departments of the United Steel Companies' Steel Works at Moss Bay, Workington, on Monday, and it is expected that there will be employment for over 1,000 men for three or four weeks at least.

Considerable progress is being made with the new dry dock which is being constructed at Swansea for Palmers Shipbuilding & Iron Company, Limited, of Jarrow-on-Tyne, and a large number of men are engaged upon the work.

At a meeting of the Scottish Centre of the Institution of Electrical Engineers, held last week in Glasgow, Mr. J. Rosen, Heaton Works, Newcastle-on-Tyne, read a paper on "Some Problems in High-Speed Alternators and their Solution."

The British Non-Ferrous Metals Research Association has arranged for Mr. Dartrey Lewis to lecture on his research work on "Materials used for the Abrasion and Polishing of Metals" at Sheffield and at Birmingham.

A meeting of the Scottish Centre of the Institution of Automobile Engineers was held on February 19 in the Royal Technical College, Glasgow. Mr. J. F. Henderson, chairman of the centre, presided, and Mr. J. L. Chaloner read a paper on "High-Speed Oil Engines."

Under the auspices of the North-East Coast Institution of Engineers and Shipbuilders and the chairmanship of Sir Archibald Ross, at Newcastle on February 16, Professor A. L. Mellanby read a paper, by Mr. W. Kerr and himself, entitled "A Review of Turbine Troubles and their Causes."

It is officially stated that an order has recently been placed with Sir W. G. Armstrong, Whitworth & Company, Limited, for the construction of 20 locomotives for the Indian State railways. These engines are of the 0-6-0 type and will be employed in goods traffic. The Vulcan Foundry Company of Newton-le-Willows have been successful in obtaining an order for 55 passenger engines, of the 2-8-0 type, for the same railways.

The Newcastle Branch of the Institution of British Foundrymen has been the first to found a junior section. At the opening meeting Mr. H. J. Young, the branch president, said their object was to raise the tone of foundrymen, and to educate the young men entering the business. Mr. H. F. Clements was elected president; Messrs. H. C. Jay and S. D. Blenkinsop vice-presidents. The secretary is Mr. J. E. O. Little, 83, Rothwell Road, Gosforth.

At a meeting of the directors of the London Iron & Steel Exchange, held last week, the following resolution was passed: "That the attention of the directors of the London Iron & Steel Exchange, having been called to the evasion of contracts by Continental sellers on the plea of 'Force Majeure,' it was resolved that a special meeting of the Committee of Management of the Exchange be called to consider the position." As we have already reported, many Continental sellers are repudiating their contracts on the grounds of "Force Majeure," caused by recent developments, and British buyers are seriously affected as a result. The special meeting of the Management Committee will take place on Wednesday, February 28, when the whole position will be thoroughly discussed.

Company News.

Buyers of Scrap Metal, Limited.—Capital £100 in £1 shares. Directors: D. H. Barnard and J. H. Barnard.

Siderton Steel Company, Limited.—Capital £1,000. Solicitors: Herbert Smith, Goss, King & Gregory, 62, London Wall, London, E.C.2.

David Tod, Limited, 240, Easter Road, Edinburgh.—Capital £5,000 in £1 shares. Coppersmiths. Directors: D. V. Tod and J. R. Deane.

E. Barwick, Limited, Ruswarp, near Whitby, Yorks.—Capital £1,500. Marine and general engineers, etc. Directors: E. Barwick (governing director) and Anna Barwick.

Sherborne Electric Supply Company, Limited.—Capital £15,000. Directors: A. R. Rawlence, E. R. Rickett, E. W. Tayler, A. N. Rye, and W. E. Brandreth.

Seth, Carr & Company, Limited, 6, Mincing Lane, London, E.C.3.—Capital £10,000 in £1 shares. Dealers in metals, etc. Permanent directors: N. T. C. Sargent, E. Seth, and F. E. Carr.

Allens Green Foundry, Limited, Allen Green, Radcliffe, Lancs.—Capital £600 in £1 shares. Directors: F. Tunnah, J. W. Allen, W. Whitehead, and J. Wizard. Secretary: J. W. Clegg.

Dimmers, Limited, 18, Dartmouth Road, Forest Hill, London, S.E.23.—Capital £2,500 in £1 shares. Founders. Directors: Mrs. L. H. Williams, H. J. Taylor, and F. S. Burgess. Secretary: Kathleen M. Burgess.

Lion Foundry Company, Limited.—Profit, £13,054; dividends for year, 8 per cent. per annum on preference, 10 per cent. per annum on ordinary, and a corresponding percentage on deferred, all less tax, £2,346; carried forward, £11,708.

Charles Clifford & Son, Limited.—Net profit, £6,826; available, £25,867; interim dividends on preference and ordinary, £3,377; six months' dividend on ordinary, 10 per cent. per annum, plus bonus 5 per cent., both free of duty; carry forward, £16,637.

Lewis Brothers (Cardiff), Limited, 109, Bute Street, Cardiff.—Capital £10,000 in £1 shares. Builders or manufacturers of railway carriages and wagons, trucks, locomotives, engines and rolling stock, of all kinds, etc. Permanent directors: T. S. Lewis (chairman), S. Lewis and W. Lewis.

Mather & Platt, Limited.—Net profit, £365,534; transferred to income-tax equalisation account, £53,694; brought forward, £287,662; available, £599,502; final dividend on ordinary, 7 per cent. and bonus 5 per cent., both free of tax, making 15 per cent. for year; reserve, £200,000; carry forward, £174,953.

Merry & Cuninghame, Limited.—Loss for year, £23,193; general expenses, etc., £16,795; dividend on 7 per cent. preference shares, paid, £8,750; interest paid on debentures, £8,975; less balance at credit at November 30, 1921, £3,958; net loss, £53,755; transferred from dividend suspense account, £8,750; loss carried forward, £45,005.

Personal.

Mr. Douglas Vickers and Mr. E. Madge, of Vickers, Limited, have been elected on the board of the Reshitza Steel Company, Bucharest.

The late Sir Johnstone Wallace, a former president of the North of England Association of Iron, Steel and Metal Merchants, left £7,470.

Mr. G. B. R. Taverner and Mr. T. M. Willis are the directors of British Pig-irons, Limited, Abbey House, Victoria Street, Westminster, London, S.W.1.

The Right Hon. Earl of Midleton, K.P., P.C., a director of the Barrow Hematite Steel Company, Limited, is at present in the United States on a business trip.

Mr. J. Y. M. Kennedy has been elected a director of Donkin & Company, Limited, engineers and steering gear manufacturers, etc., St. Andrews' Works, Walkergate, Newcastle-on-Tyne.

Mr. D. Thomson has resigned his position as chairman of Walkers, Parker & Company, Limited, though he will retain his seat on the board as director, and to fill the vacancy Mr. George Strachan Pawle has been elected chairman.

Capt. the Hon. R. D. Kitson, a director of the Monk Bridge Iron and Steel Company, Limited, of Leeds, met with an accident while on a visit to the Riviera, as a consequence of which he will probably lose the sight of one, if not both, of his eyes.

Sir Alfred Yarrow has given £100,000 to the Royal Society, to be used as capital or income, as the council may think fit, for the better promotion of original scientific research. The offer of this magnificent sum has been gratefully accepted by the council.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The position of the Cleveland iron market is, if anything, more difficult than was outlined in previous reports, practically famine conditions prevailing, both for home and export supplies, while prices continue on an advancing scale for any small parcels of pig available in makers' stocks. Consequently, demand has been checked for the time being, and business on 'Change is completely demoralised. There is at present hardly any possibility of meeting orders for prompt delivery, while makers very naturally decline to name prices for forward iron, the question of future fuel supplies retarding an extension of business beyond the end of the current quarter. Some ironmasters are already committed beyond that date on contracts completed while iron was comparatively cheap, covering March/April, and unless a downward movement in coke prices should be possible in the meantime must find the business unprofitable. The fuel famine is, of course, distinctly traceable to the happenings on the Ruhr, coke being exported to the Continent on a freer scale than would have been the case in normal conditions. Efforts are, however, being made by Tees-side smelters to increase supplies of Cleveland iron, the Skinningrove Iron Company, Limited, being about to put in another furnace on Cleveland iron, and the Cargo Fleet Iron Company, Limited, are restarting a furnace on basic iron. Cleveland No. 3 G.M.B. is now extremely scarce. Occasional small parcels come into the market, and these are making remarkable prices.

The hematite position is stronger than ever. There is a big steelworks demand, which looks like extending to Scotland, and foundries are undoubtedly buying hematite owing to the price and scarcity of foundry iron. There is apparently very little change in the export position if comparison is made with last month, and it is certainly not going to be helped by advancing prices. East Coast mixed numbers this week were done at 115s., and this is now the nearer figure. But there is now very little prompt iron to be had. Cumberland and North Lancashire hematite smelters are fully employed, and outputs are insufficient to meet demands.

MANCHESTER.—In this important centre of the iron foundry trade it is, at all events, satisfactory to report that consumers in the district, depending practically on Midland makers for their supplies of pig, are still enabled to buy on somewhat more favourable terms than those in other localities, there being quite recently at least one brand of Derbyshire No. 3 which could be bought at 90s. at the furnaces, for prompt delivery, but it may be doubted whether any iron of that quality could now be bought at that price. Most makers quote 92s. 6d., and some 95s. at the furnaces, which would mean about 101s. to 103s. 6d. per ton delivered in Manchester. As, however, the Cleveland ironfounder must pay at least 120s. for the same quality of iron, it cannot be said that the Manchester consumer is badly off, and a good many ironfounders here have yet to receive Derbyshire and other Midland brands at 90s. per ton delivered.

THE MIDLANDS.—Conditions in this area differ little in essentials from those obtaining in other districts, the expansion of demand for pig-iron anticipated a short time ago having been checked by the unexpected advance in prices, due to the present exorbitant cost of fuel supplies. As a consequence there is very little iron available for prompt sales, and for what there is fancy terms are now obtainable; prices such as would only be paid in an emergency, and which cut into what little profit there was on the finished goods. The one great essential at the moment is a large increase in the production of fuel and a return to reasonable prices for it, but neither development seems within measurable distance, and consequently business is restricted at a time when everyone looked for steady expansion.

SCOTLAND.—Conditions in the Scottish pig-iron market of late have disclosed further strength in the buying movement, both on home and export account, while prices have sharply advanced. It is difficult to quote exact figures, as the experience of buyers of late has been that prices named in the morning were out of date before the day finished.

Finished Iron.

The market for most descriptions of finished material continues quietly active, and most of the bar mills in the South Staffordshire area are fairly well provided with specifications. Very few makers are, however, working to full capacity, and there is still some idle plant in the district. Market conditions remain firm and prices show a hardening tendency, even nut and bolt iron having stiffened up to £10 15s., though this figure is 5s. below that quoted by Lancashire.

Steel.

Business in the various branches of the steel industry is again on the up-grade, the expansion of demand now extending north to Scotland, where several works, long idle, have now been restarted. In Sheffield also the market for steel and semi-products increases in activity, the more recent development having been the reopening of the Templeborough works of Messrs. Steel, Peech & Tozer, and of the Penistone works of Messrs. Cammell, Laird & Company, which will provide employment for a large number of hands. In this district also there is a decided scarcity of billets, both acid and basic, and any lots available are promptly absorbed.

Metals.

Copper.—Towards the close of last week markets for standard copper, both at home and abroad, developed remarkable strength and, notwithstanding resales on German account, values marked a further advance. America was again a heavy buyer, but strong though the position may be in that country, conditions in the States seem scarcely to warrant the increase that has taken place. Relying as we do, of course, on supplies from America, the home market must naturally follow to some extent the fluctuations across the Atlantic, but at the same time the rise may be overdone. The outlook in the metal-consuming trades has recently been more hopeful, but manufacturers are having a severe struggle and have quite enough to contend with without being compelled to pay uneconomical prices for their raw material. A remedy to alleviate the position, however, is difficult to discover, as unless the margin between standard and electro copper is to widen still further, prices can hardly come much lower. Current quotations :—*Cash* : Wednesday, £68 17s. 6d.; Thursday, £69 17s. 6d.; Friday, £71; Monday, £71 15s.; Tuesday, £72. *Three Months* : Wednesday, £69 12s. 6d.; Thursday, £70 12s. 6d.; Friday, £71 15s.; Monday, £72 7s. 6d.; Tuesday, £72 15s.

Tin.—Movements in this metal at last week's close were even more exciting than in the copper market, values mounting rapidly until the £200 level was reached, making the advance so far this month of upwards of £15 per ton. This demonstration of strength may be mainly attributed to speculative buying on a heavy scale, in conjunction with substantial support from America, the latter being a dominant factor in the market. Home consumers have also evidenced more interest in the market and have taken larger quantities, while the demand from the Continent shows some improvement. The tinplate makers in South Wales have recently been obtaining better orders for their products, but it is likely that the fresh advance in tin prices may make them reluctant to accept further forward business until it is seen to what extent the advance will be maintained. The Straits have recently sold fairly freely, but have shown some reluctance to dispose of the metal during the last day or two. Current quotations :—*Cash* : Wednesday, £193 5s.; Thursday, £197 15s.; Friday, £200 10s.; Monday, £199 10s.; Tuesday, £201. *Three Months* : Wednesday, £195; Thursday, £199 2s. 6d.; Friday, £202 5s.; Monday, £201 10s.; Tuesday, £202 15s.

Spelter.—In common with other metals, the market for spelter has also advanced values, quotations having at the week-end reached upwards of £35. Although spelter production in the United States is now large, and there may even be an exportable surplus, available supplies throughout the world are at a low level. With the prospects of a revival of trade, it is thought that higher prices for spelter will be realised in the early future. Current Quotations :—*Ordinary* : Wednesday, £35 16s. 3d.; Thursday, £35 17s. 6d.; Friday, £36 2s. 6d.; Monday, £36 10s.; Tuesday, £37.

Lead.—The demand for soft foreign pig also shows some improvement, while the statistical position is strong. American prices are above the London parity, and holders here are hardly likely to make concessions, since any decline in our market would make it possible to ship from here to America. This is keeping the market firm to strong. Current Quotations : —*Soft foreign (prompt)* : Wednesday, £28 10s.; Thursday, £29 5s.; Friday, £29 7s. 6d.; Monday, £29 7s. 6d.; Tuesday, £29 7s. 6d.

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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	72	0	0
Three months	72	15	0
Electrolytic	79	10	0
Tough	74	10	0
Best selected	74	10	0
Sheets	104	0	0
India	90	0	0
Wire bars	79	10	0
Do. Mar.	79	10	0
Do. Apr.	79	10	0
Ingot bars	79	10	0
H.C. wire rods	84	0	0
Off. aver., cash, Jan.	64	11	1 7/11
Do. 3 mths., Jan.	65	3	9
Do. Settlement Jan.	64	11	0 8/11
Do. Electro, Jan.	71	10	10 10/11
Do. B.S., Jan.	69	2	2 2/3
Aver. spot price, copper, Jan.	64	9	10½
Do. Electro, Jan.	73	13	7½

Solid drawn tubes 14d.
Brazed tubes 14d.
Wire 11d.
Yellow metal rods 7¼d.
Do. 4x4 Squares 8¾d.
Do. 4x3 Sheets 9¾d.

BRASS.

Solid drawn tubes 12¼d.
Brazed tubes 13½d.
Rods, drawn 10⅝d.
Rods, extruded or rolled 7d.
Sheets to 10 w.g. 10¼d.
Wire 10⅝d.
Rolled metal 10d.

TIN.

	£	s.	d.
Standard cash	201	0	0
Three months	202	15	0
English	201	10	0
Bars	203	10	0
Chinese	199	10	0
Straits	208	15	0
Australian	204	0	0
Eastern	209	0	0
Banca	204	0	0
Off. aver., cash, Jan.	181	18	6 21/32
Do. 3 mths., Jan.	183	9	5 19/32
Do. Sttlment, Jan.	181	18	4 10/11
Aver., spot, Jan.	181	17	0½

SPELTER.

	£	s.	d.
Ordinary	37	0	0
Remelted	34	5	0
Hard	29	0	0
Electro 99.9	43	10	0
English	38	0	0
India	30	0	0
Prime Western	38	0	0
Zinc dust	50	0	0
Zinc ashes	14	0	0
Off. aver., Jan.	34	16	8 25/44
Aver., spot, Jan.	35	14	8

LEAD.

	£	s.	d.
Soft foreign ppt	29	7	6
English	30	10	0
Off. average, Jan.	26	18	6 3/11
Average, spot, Jan.	27	2	4½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	44	0	0
Do. V.M. ex whf.	42	0	0
Dutch	42	0	0
Rods	49	0	0
Boiler plates	41	0	0
Battery plates	42	0	0

ANTIMONY.

	£	s.	d.
English regulus	27	10	0
Special brands	33	10	0
Chinese	24	15	0
Crude	19	10	0

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Quicksilver 10 2 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% £12 5 0
75% £19 10 0
Ferro-vanadium—
35/40% 17/- lb. va.
Ferro-molybdenum—
70/75% c. free 9/- lb. mo.
Ferro-titanium—
23/25%, carbonless 1/1 lb.
Ferro-phosphorus, 20/23%, £23
Ferro-tungsten—
80/85%, carbon free 1/5 lb.
Tungsten metal powder—
98/99% 1/10½ lb.
Ferro-chrome—
4/6% car. £21 0
6/8% car. £20 0
8/10% car. £19 10
Ferro-chrome—
Max. 2% car. £55 0
Max. 1% car. £65 0
Max. 0.70% car. £75 0
67/70%, carbonless 1/6½ lb.
Nickel—99%, cubes or pellets £130 0
Cobalt metal—98/99% 11/6 lb.
Aluminium—98/99% £100
Metallic Chromium—
96/98% 4/6 lb.
Ferro-manganese (net)—
76/80%, loose £16
76/80%, packed £17
76/80%, export £16
Metallic manganese—
94/96%, carbonless 2/2 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% s. d. tungsten 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	4	10	0	4	15	0
Bundled steel & shearings	4	0	0	4	10	0
Mixed iron & steel	4	2	6	4	7	6
Heavy cast iron	4	0	0	4	5	0
Good machinery for foundries	4	2	6	4	7	6
Cleveland—						
Heavy steel	4	5	0			
Steel turnings	3	7	6			
Cast-iron borings	3	7	6			
Heavy forge	5	0	0			
Bushelled scrap	3	16	9			
Cast-iron scrap	4	12	6			
Lancashire—						
Cast-iron scrap	4	5	0			
Heavy wrought	4	10	0			
Steel turnings	3	0	0			
London — Merchants' buying prices delivered yard.						
Copper (clean)	61	0	0			
Brass (clean)	36	10	0			
Lead (less usual draft)	25	0	0			
Tea lead	23	0	0			
Zinc	25	0	0			
New aluminium cuttings	67	0	0			
Braziery copper	55	0	0			
Gun metal	47	0	0			
Hollow pewter	155	0	0			
Shaped black pewter	100	0	0			

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N. E. Coast—		
Foundry No. 1	125/-	
Foundry No. 3	120/-	
Forge No. 4	110/-	
Mottled	—	
Hematite No. 1	116/-	
Hematite M/Nos.	115/-	
Midlands—		
Staffs. common	—	
,, part-mine forge	—	
,, ,, foundry	—	
,, Cold blast, ord.	200/-	
,, ,, roll iron	210/-	
,, basic	—	
Northants forge	82/6	
,, foundry No. 3	90/-	
,, basic	100/-	
Derbyshire forge	87/6	
,, foundry No. 3	95/-	
,, basic	100/-	
Scotland—		
Foundry No. 1	116/6	
,, No. 3	111/6	
Hematite M/Nos.	117/6	
Sheffield (d/d district)—		
Derby forge	90/-	
,, foundry No. 3	95/-	
Lincs. forge	95/-	
,, foundry No. 3	100/-	
,, basic	105/-	
E.C. hematite	125/3	
W.C. hematite	123/9	
All d/d in the district.		
Lancashire (d/d eq. Man.) —		
Derby forge	—	
,, foundry No. 3	103/6	
Northants foundry No. 3	—	
Cleveland foundry No. 3	—	
Staffs. foundry No. 3	—	
Lincs. forge	—	
,, foundry No. 3	105/-	
Summerlee foundry	128/6	
Glengarnock foundry	128/6	
Gartsherrie foundry	128/6	
Monkland foundry	128/6	

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Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	£11	0	to 12	0	0	
Angles	£11	0	0 to 12	5	0	
Tees to 3 united ins.	11	10	0			
Nut and bolt	10	15	0			
Hoops	15	0	0			
Marked bars (Staffs.)	13	10	0			
Gas strip	£10/15	to	£11			
Bolts and nuts, ¾ in. × 4 in.	18	0	0			
Steel—						
Ship plates	£9	10/-	to 10	0	0	
Boiler plates	14	0	0			
Chequer plates	10	15	0			
Angles	£9	10	0 to 9	15	0	
Tees	£9	12	6 to 10	0	0	
Channels	9	5	0			
Joists	9	10	0			
Rounds & squares 3 in. to 5½ in.	11	0	0			
Rounds under 3 in. to ⅜ in.	10	15	0			
Flats, over 5 in. wide and up	11	5	0			
Flats, 5 in. to 1½ in.	10	10	0			
Rails, heavy	9	10	0			
Fishplates	13	10	0			
Hoops	11	10	0			
Black sheets, 24 g.	13	10	0			
Galv. cor. sheets, 24 g.	£19	5	0 to 19	10	0	
Galv. fencing wire, 8 g. plain	16	0	0			
Rivets, ¾ in. dia.	13	0	0			
Billets, soft	8	5	0 to 9	10	0	
Billets, hard	8	15	0 to 10	5	0	
Sheet bars	8	0	0 to 8	5	0	
Tin bars	8	6	0			

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3½
Sheet	1 4½
Wire	1 4¼
Rods	1 3
Tubes	1 6½
Castings	1 1½

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10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4¾ to 1/10¾
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6¼ to 2/0¼
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/- to 1/6
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	29.76
No. 2 foundry, Valley	27.00
No. 2 foundry, Birm.	24.50
Basic	27.96
Bessemer	29.77
Malleable	28.96
Grey forge	28.27
Ferro-manganese 80% delivered	107.50
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	40.00
O.-h. billets	40.00
O.-h. sheet bars	40.00
Wire rods	50.00
	Cents.
Iron bars, Phila.	2.47
Steel bars	2.15
Tank plates	2.20
Beams, etc.	2.15
Skelp, grooved steel	2.20
Skelp, sheared steel	2.20
Steel hoops	2.90
Sheets, black, No. 28	3.60
Sheets, galv., No. 28	4.60
Sheets, blue an'l'd, 9&10	2.65
Wire nails	2.80
Plain wire	2.65
Barbed wire, galv.	3.55
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry 40/- to 45/-
,, furnace 30/- to 35/-
Durham & North. fdy. 39/-
,, furnace 33/-
Other Districts, foundry 39/-
,, furnace 30/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C.Cokes,	20×14, box	21/9
,,	28×20, ,,	43/6
,,	20×10, ,,	31/6
,,	18¾×14, ,,	22/6
C.W.	20×14, ,,	19/9
,,	28×20, ,,	40/6
,,	20×10, ,,	28/3
,,	18¾×14, ,,	20/6
Ternes, f.o.t.	28×20, ,,	39/-

TUBES.

Up to and incl. 6 in.

Gas .. ..57½% } Tube prices
Water ..52½% } are
Steam ..47½% } now free.

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23
Rolled Ordinary—Assortment .. £ s. d.
Nail Rods—Square, round and flats .. 16 10 0 to 17 5 0
Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32
Blooms—
Single welded .. £10 to £11
Billets—
Single and double welded .. .. £13 to £14
Pig-iron—
Grey, white or mottled £6 10 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Feb. 21	68	17	6	dec.	2/6
„ 22	69	17	6	inc.	20/–
„ 23	71	0	0	„	22/6
„ 26	71	15	0	„	15/–
„ 27	72	0	0	„	5/–

Electrolytic Copper.

Feb. 21	75	10	0	dec.	10/–
„ 22	76	10	0	inc.	20/–
„ 23	77	10	0	„	20/–
„ 26	79	0	0	„	30/–
„ 27	79	10	0	„	10/–

Standard Tin (cash).

Feb. 21	193	5	0	inc.	35/–
„ 22	197	15	0	„	90/–
„ 23	200	10	0	„	55/–
„ 26	199	10	0	dec.	20/–
„ 27	201	0	0	inc.	30/–

Tin (English ingots).

Feb. 21	193	5	0	inc.	35/–
„ 22	197	15	0	„	90/–
„ 23	200	10	0	„	55/–
„ 26	200	0	0	dec.	10/–
„ 27	201	10	0	inc.	30/–

Zinc Sheets (English).

Feb. 21	44	0	0	No change	
„ 22	44	0	0	„	
„ 23	44	0	0	„	
„ 26	44	0	0	„	
„ 27	44	0	0	„	

Spelter (ordinary).

Feb. 21	35	16	3	dec.	3/9
„ 22	35	17	6	inc.	1/3
„ 23	36	2	6	„	5/–
„ 26	36	10	0	„	7/6
„ 27	37	0	0	„	10/–

Lead (English).

Feb. 21	29	15	0	inc.	5/–
„ 22	30	5	0	„	10/–
„ 23	30	10	0	„	5/–
„ 26	30	10	0	No change	
„ 27	30	10	0	„	

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2	
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 11	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	43 6	43 1	45 3	
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 0
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7¼	50 10	49 10	49 2	48 10	49 8¼	49 3½	49 7¾	49 6¼	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5¼	64 6¾	61 7½	66 8¼	67 8	68 0	58 5½
1913	66 11¼	63 8½	64 8	67 1½	66 3	56 9¾	56 3¼	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0¼	51 4½	51 6	51 6¾	51 5	52 3	51 5	50 1	50 3	53 0	51 4¼
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0¾	65 3	65 11	69 10¼	75 7½	65 7½
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	91 3	
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½

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IRON & STEEL SCRAP

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ENGINEER, age 39, M.I.Brit.F., 23 years' experience home and abroad, Works, Office Correspondence, Brass and Iron Foundry Practice, General Engineering, Steel and Ironworks Plant, Locomotives and Rolling Stock, etc., desires responsible position Works or Office. —STEPHEN MOSS HOLDEN, c/o 99, Plantation Street, Accrington, Lancashire.

OF INTEREST TO FOUNDRIES POSSESSING NO LABORATORY.—Metallurgist and Foundry Chemist, who has specialised for the last twenty years in all classes of foundry practice, is open to act as Metallurgical Consultant and Chemist. Advertiser has own well-equipped Laboratory for undertaking the necessary Analytical work and Tests. Confidential work and moderate charges.—Write, Box 324, FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

LATE PRODUCTION MANAGER of well-known firm desires position; experience in Engine and Ordnance Work, Colliery and General Engineering.—Apply, W. LAING, 4, Main Road, Handsworth, Sheffield.

THE Lancashire Branch of the Institution of British Foundrymen beg to announce that several members, who have had varied experience as Foremen, etc., are at present disengaged. Employers who are in need of Foremen or other members of their foundry staff are invited to communicate with the Honorary Secretary, T. MAKEMSON, 21, Beresford Road, Stretford, Manchester.

REPRESENTATIVES Wanted for all districts to Sell Special Pig-irons on commission basis. Must have live connections.—State full particulars, district covered, present agencies held (if any), age, and experience, by letter, to Box 356, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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INVENTORS Advice, Handbook and Consultations Free. KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Regd. Patent Agent, 146a, Queen Victoria Street, London; 36 years' references.

NOTICE.

ROYAL SHOW

NEWCASTLE-UPON-TYNE,

July 3rd to 7th, 1923.

EXHIBITION OF IMPLEMENTS, &c.

The Regulations and Forms of Application for Space are now ready.

Applications must be made by

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Live Stock entries close on MAY 1st; Poultry, Rabbits, Produce, Forestry and Horticultural Exhibitions on May 21st; Competitions for Plantations, Home Nurseries, Orchards and Fruit Plantations on MAY 1st.

T. B. TURNER, Secretary.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND,
16, Bedford Square, London, W.C.1.

January, 1923.

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WANTED, a small Tilting Furnace for brass melting, either gas or coke-fired; by Green or Morgan preferred.—Box 352, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, London, W.C.2.

TWO VERTICAL BOILERS, by Ruston, 14 ft. high x 7 ft. diameter, 120 lbs. w.p. 26-H.P. Hornsby Oil Engine, equal to new. 15-H.P. Electric Motor, 460 volts D.C., with Starter. Brand New 4 ft. Under-Driven Sand Mill. Weir Type Boiler Feed Pump, 1,500 gallons per hour, 140 lbs. pressure.

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8-FT. Swing Vertical Boring and Turning Mill, by J. Hetherington, Ltd.; table 7 ft. diam., to take 5 ft. under cross slide. Horizontal Boring Machine, by the Lucas Machine Tool Co., Ltd.; 3 in. spindle, T-slotted table 3 ft. 6 in. x 1 ft. 10 in. Ten nearly new 18 in. centres A1 Geared Head, arranged for motor drive, S.S.S. Lathes on 34 ft. 3 in. bed, by G. & A. Harvey, Ltd. Two Twin Spindle Vertical Boring, Drilling and Tapping Machines, by D. & J. Tullis; 2¾ in. spindles, working surface of table 5 ft. 6 in. x 4 ft. 0 in. Two nearly new No. 3 Kempsmith Universal Milling Machines, with equipment. No. 5 Vertical Milling Machine, by Brown & Sharpe, with rising and falling head; working surface of table 4 ft. 3 in. x 1 ft. 4 in. Planing Machine, to plane 14 ft. x 5 ft. x 4 ft., two tool boxes on cross slide, by J. Buckton & Co., Ltd. 14 in. centres Crank Turning Lathe on 11 ft. 6 in. bed, by Thos. Ryder & Sons. Multiple Punching Machine, by Rushworth, capacity 33 holes—17/32 in. diam., through plates 3/16 in. thick. 15 in. stroke Pillar Type Shaping Machine, T-slotted table 12 in. x 12 in. x 12 in., by Potter & Johnson.

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EVANS' MAGNETIC SEPARATOR, good order, **£18.**

SELECTIONS from boxes in SLOUGH STOCK.

240 pairs, 18 in. x 8 in., cast iron, interchangeable, **8/6** pair.
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